

**NORTHERN NEW ENGLAND PASSENGER
RAIL AUTHORITY
Wells, Maine**

WELLS STATION EXPANSION

WELLS TRANSPORTATION CENTER

PROJECT SPECIFICATIONS



PROJECT SPECIFICATIONS

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SECTION 010000

GENERAL CONDITIONS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Construction under this contract shall be performed in accordance with these project specifications and the DIVISION 100 – GENERAL CONDITIONS only of the State of Maine Department of Transportation Standard Specifications, Revision of March 2020, as updated through advertisement, except as modified or supplemented within these contract documents as follows, to reflect the fact that this project is owned and administered by the Northern New England Passenger Rail Authority (NNEPRA).
1. Wherever the words “State” or “State of Maine” or “Treasurer – State of Maine” appear in the context of the owner of the project, substitute “NNEPRA”.
 2. Wherever the words “Maine Department of Transportation”, “MaineDOT”, or “Department” appear in the context of the owner or administrator of the project substitute “NNEPRA”.
 3. Wherever the word “Commissioner” or “Chief Engineer” or “Program Manager” appears substitute “NNEPRA Executive Director”.
 4. “Project Manager” is hereby defined as the NNEPRA project representative, or other agent, designated by NNEPRA for overall coordination of the project.
 5. “Resident” is hereby defined as the NNEPRA designated on-site representative during construction.
- B. All contractors bidding on this project or performing work under the contract are required to familiarize themselves with DIVISION 100 – GENERAL CONDITIONS of the MaineDOT Standard Specifications. It is the Contractor’s responsibility to obtain copies of the MaineDOT Standard Specifications for his/her use. They are available at <http://www.maine.gov/mdot/contractors/publications/>. The Contractor shall have at least one copy of the MaineDOT Standard Specifications on the project site at all times.
- C. The following specific sections of DIVISION 100 – GENERAL CONDITIONS of the MaineDOT Standard Specifications shall be modified as follows:
1. 101.2 Definitions – Add
“Architect The project’s design architect of record.
Authority The Northern New England Passenger Rail Authority.
Engineer The project’s civil, structural, geotechnical, mechanical, electrical, or plumbing design engineer of record, as applicable.”
 2. 105.7 Working Drawings - Add section 105.7.6 Submittal Coordination
“105.7.6 Submittal Coordination

A. Shop drawings shall show design, dimensions, connections, and other details necessary to ensure that the Contract Documents are accurately interpreted. Shop drawings shall show proper connections with adjoining work in detail.

1. Where adjoining work requires shop drawings, such drawing must be submitted for approval at the same time so that connections can be accurately checked. Contractor shall provide a list of submittals, to the Resident for review and approval, to be packaged and delivered simultaneously for adjoining work.

B. Shop drawings shall establish the actual detail of all manufactured or fabricated items, indicate proper relation to adjoining work and amplify design details of mechanical and electrical equipment in the physical spaces in any structure and incorporate minor changes of design or construction details to suit actual conditions.

1. Where separate sections or trades are involved, shop drawings shall be coordinated and where required by the Resident shall be submitted in composite form (coordination drawings) clearly designating which trade will perform which work; the words "work by others", as it applies to all subcontractors, suppliers, etc. to the Contractor, will not be accepted. Contractor shall provide a list of submittals, to the Resident for review and approval, to be packaged and delivered simultaneously for coordination of work."

3. 106.4.6 QCP Non-Compliance - Delete section and replace with the following:

"The Contractor shall comply with the approved QCP and shall take all other steps necessary to assure a high quality project.

Failure by the Contractor to comply with the approved Quality Control Plan will result in a letter describing the violation and a mandatory work suspension. The Contractor shall submit a letter to NNEPRA that details the corrective action made to address the violation(s) in its Quality Control Plan. Work may resume when NNEPRA is satisfied the corrective action will result in adherence to the Quality Control Plan."

4. 106.6 Acceptance - Delete section and replace with the following:

"The Department is responsible for determining the acceptability of the Work. Acceptance of the Material is based on the visual inspection of the construction, monitoring of the Contractor's QCP, and Acceptance Test results. Acceptance sampling and testing is the responsibility of the Department (unless alternate procedures are specified) except for furnishing facilities, testing equipment, transportation, and Material samples as required.

The Department may reject Material that appears to be defective based on visual inspection. No payment will be made for the Materials rejected by the Department.

Prior to Contractor's knowledge of the sample location, the Contractor may remove and replace defective Material at no cost to the Department. The Department will sample, test, and evaluate new Material for acceptance."

5. 106.7 Quality Level Analysis – Not Applicable

6. 107.4.3 Projected Payment Schedule - Delete section and replace with the following:

“The Contractor shall provide NNEPRA with a Quarterly Projected Payment Schedule that estimates the value of Work as scheduled, including requests for payments of Delivered Materials. The Projected Payment Schedule must be in accordance with the Contractor’s Schedule of Work and the approved Schedule of Values. The Contractor shall submit Projected Payment Schedule as a condition of Award.”

7. 108.2.3 Mobilization Payments - Delete section and replace with the following:

“ ‘Mobilization’ includes the mobilization and demobilization of all resources as many times as necessary during the Work.

Upon approval of all pre-construction submittals required for approval by this Contract, including those listed in Section 104.4.2 Preconstruction Conference, the Contractor will receive payment of 50% of the Lump Sum price in the approved Schedule of Values, not to exceed 5% of the Bid. After NNEPRA determines that the Work is 50% complete, the Contractor will receive the other 50% of the Lump Sum price for Mobilization in the approved Schedule of Values, not to exceed 5%. Any remaining portion of the Lump Sum price for Mobilization, in the approved Schedule of Values, will be paid upon Final Acceptance.”

8. 108.4.1 Price Adjustment for Hot Mix Asphalt – Not Applicable

9. APPENDIX A TO DIVISION 100 – Delete this entire section and replace with the attached APPENDIX A TO DIVISION 100.

1.2 RAILROAD REQUIREMENTS

- A. The railroad owner is CSX TRANSPORTATION, INC. (CSX/CSXT). Prior to construction start, the Contractor shall coordinate with CSX to obtain a fully executed Construction Agreement, a sample of which is attached to this specification in Appendix A. Any submittals noted in Appendix B as being submitted by the Agency or it’s Contractor shall be prepared and submitted by the Contractor.
- B. The Contractor shall prepare and submit all submittals required by CSX, as outlined in Appendix B – CSXT Construction Submission Criteria. All submittals shall be stamped by a Professional Engineer licensed in the State of Maine.
- C. The Contractor shall arrange and conduct its work so that there will be no interference with CSX operations, including, but not limited to train (no train schedule will be provided), signal, telephone, and telegraphic services; or damage to CSX’s property, or to poles, wires, and other facilities of tenants on CSX’s Property or right-of-way. Contractor shall store materials so as to prevent trespassers from causing damage to trains, or CSX Property.
- D. The Contractor must plan and perform the work in a manner such that the CSXT track at the project location remains fully capable of carrying rail traffic throughout the work period and rail traffic is not delayed or otherwise impacted due to the work being performed. Whenever Work is likely to affect the operations or safety of trains, or has the potential to foul the track, the method of doing such Work shall first be submitted to the CSX Representative for approval, but such approval shall not relieve the Contractor from liability in connection with such Work.
- E. Storage of materials, debris, or equipment on CSXT right-of-way is not permitted. The CSXT right-of-way and adjacent areas shall be cleared and kept free of debris prior to and during construction. During and after completion of construction, the Authority or its contractor must clear CSX’s property

of all incidental debris to the satisfaction of CSX's construction engineering and inspection representative.

- F. Upon construction completion, Contractor shall provide CSX with a full set of electronic as-built drawings, showing actual measured vertical and horizontal clearances.
- G. All personnel working on CSX property for the Contractor shall complete "CSX Roadway Worker Protection Training for Railroad Contractors."
- H. The Contractor shall adhere to the CSXT Construction Submission Criteria, a sample of which is attached to this specification in Appendix B.
- I. The Contractor shall adhere to the CSX Soil and Water Management Policy, a sample of which is attached to this specification in Appendix C.

1.3 MAINE TURNPIKE AUTHORITY REQUIREMENTS

- A. The Maine Turnpike Authority (MTA) is the owner of the property on which the existing Wells Transportation Center is located. Prior to construction start, the Contractor shall apply for and obtain a fully executed Maine Turnpike Authority Work Permit/License, a sample of which is attached to this specification in Appendix D.

1.4 COORDINATION DRAWINGS

- A. Prior to the submission of any coordination drawings, the Contractor shall meet with the Authority, cross-laminated timber, electrical, and fire alarm suppliers/subcontractors, and any other suppliers/subcontractors whose work will include routing conduit and penetrating the cross-laminated timber panels. The intent of this meeting is to discuss the placement and concealment of conduit and penetrations. See Section 061800 for additional requirements.

END OF SECTION

**APPENDIX A -
CSX CONSTRUCTION AGREEMENT**

APPENDIX

CSX TRANSPORTATION

CONSTRUCTION AGREEMENT

CONSTRUCTION AGREEMENT

This Construction Agreement (“Agreement”) is made as of _____, 201____, by and between CSX TRANSPORTATION, INC., a Virginia corporation with its principal place of business in Jacksonville, Florida (“CSX”), and [INSERT Name of Public Agency], a body corporate and political subdivision of the State of (INSERT Name of State) (“Agency”).

EXPLANATORY STATEMENT

1. Agency has proposed to construct, or to cause to be constructed, [INSERT Project Description; eg: rehabilitation / repair of the Ridgeview Middle School Pedestrian Bridge Structure passing over CSX (DOT# 228 637B) in the vicinity of CSX milepost CD-6.15 on the Great Lakes Division, Columbus Subdivision, located in Columbus, Franklin County, Ohio] (the “Project”).
2. Agency has obtained, or will obtain, all authorizations, permits and approvals from all local, state and federal agencies (including Agency), and their respective governing bodies and regulatory agencies, necessary to proceed with the Project and to appropriate all funds necessary to construct the Project.
3. Agency acknowledges that: (i) by entering into this Agreement, CSX will provide services and accommodations to promote public interest in this Project, without profit or other economic inducement typical of other Agency contractors;
(ii) neither CSX nor its affiliates (including their respective directors, officers, employees or agents) will incur any costs, expenses, losses or liabilities in excess of payments made to CSX, by or on behalf of Agency or its contractors, pursuant to this Agreement; and
(iii) CSX retains the paramount right to regulate all activities affecting its property and operations.
4. It is the purpose of this Agreement to provide for the terms and conditions upon which the Project may proceed.

NOW, THEREFORE, in consideration of the foregoing Explanatory Statement and other good and valuable consideration, the receipt and sufficiency of which are acknowledged by the parties, the parties agree as follows:

1. Project Plans and Specifications

1.1 Preparation and Approval. Pursuant to Exhibit A of this Agreement, all plans, specifications, drawings and other documents necessary or appropriate to the design and construction of the Project shall be prepared, at Agency's sole cost and expense, by Agency or CSX or their respective contractors. Project plans, specifications and drawings prepared by or on behalf of Agency shall be subject, at CSX's election, to the review and approval of CSX. Such plans, specifications and drawings, as prepared or approved by CSX, are referred to as the “Plans”, and shall be incorporated and deemed a part of this Agreement. Plans prepared or submitted to and approved by CSX as of the date of this Agreement are set forth in Exhibit B to this Agreement.

1.2 Effect of CSX Approval or Preparation of Plans. By its review, approval or preparation of Plans pursuant to this Agreement, CSX signifies only that such Plans and improvements constructed in accordance with such Plans satisfy CSX's requirements. CSX expressly disclaims all other representations and warranties in connection with the Plans, including, but not limited to, the integrity, suitability or fitness for the purposes of Agency or any other persons of the Plans or improvements constructed in accordance with the Plans.

1.3 Compliance with Plans. The Project shall be constructed in accordance with the Plans.

2. Allocation and Conduct Of Work

Work in connection with the Project shall be allocated and conducted as follows:

2.1 CSX Work. Subject to timely payment of Reimbursable Expenses as provided by Section 4, CSX shall provide, or cause to be provided, the services as set forth by Exhibit A to this Agreement. Agency agrees that CSX shall provide all services that CSX deems necessary or appropriate (whether or not specified by Exhibit A) to preserve and maintain its property and operations, without impairment or exposure to liability of any kind and in compliance with all applicable federal, state and local regulations and CSX's contractual obligations, including, but not limited to, CSX's existing or proposed third party agreements and collective bargaining agreements.

2.2 Agency Work. Agency shall perform, or cause to be performed, all work as set forth by Exhibit A, at Agency's sole cost and expense.

2.3 Conduct of Work. CSX shall commence its work under this Agreement following: (i) delivery to CSX of a notice to proceed from Agency; (ii) payment of Reimbursable Expenses (as provided by Section 4.1) as required by CSX prior to the commencement of work by CSX; (iii) issuance of all permits, approvals and authorizations necessary or appropriate for such work; and (iv) delivery of proof of insurance acceptable to CSX, as required by Section 9. The initiation of any services by CSX pursuant to this Agreement, including, but not limited to, the issuance of purchase orders or bids for materials or services, shall constitute commencement of work for the purposes of this Section. The parties intend that all work by CSX or on CSX property shall conclude no later than [INSERT DATE], unless the parties mutually agree to extend such date.

3. Special Provisions Agency shall observe and abide by, and shall require its contractors ("Contractors") to observe and abide by the terms, conditions and provisions set forth in Exhibit C to this Agreement (the "Special Provisions"). To the extent that Agency performs Project work itself, Agency shall be deemed a Contractor for purposes of this Agreement. Agency further agrees that, prior to the commencement of Project work by any third party Contractor, such Contractor shall execute and deliver to CSX Schedule I to this Agreement to acknowledge Contractor's agreement to observe and abide by the terms and conditions of this Agreement.

4. Cost Of Project and Reimbursement Procedures

4.1 Reimbursable Expenses. Agency shall reimburse CSX for all costs and expenses incurred by CSX in connection with the Project, including, without limitation: (1) all out of pocket expenses, (2) travel and lodging expenses, (3) telephone, facsimile, and mailing expenses, (4) costs for equipment, tools, materials and supplies, (5) sums paid to CSX's consultants and subcontractors, and (6) CSX labor in connection with the Project, together with CSX labor overhead percentages established by CSX pursuant to applicable law (collectively, "Reimbursable Expenses"). Reimbursable Expenses shall also include expenses incurred by CSX prior to the date of this Agreement to the extent identified by the Estimate provided pursuant to Section 4.2.

4.2 Estimate. CSX has estimated the total Reimbursable Expenses for the Project as shown on Exhibit D (the "Estimate", as amended or revised). In the event CSX anticipates that actual Reimbursable Expenses for the Project may exceed such Estimate, it shall provide Agency with the revised Estimate of the total Reimbursable Expenses, together with a revised Payment Schedule (as defined by Section 4.3.1), for Agency's approval and confirmation that sufficient funds have been appropriated to cover the total Reimbursable Expenses of such revised Estimate. CSX may elect, by delivery of notice to Agency, to immediately cease all further work on the Project, unless and until Agency provides such approval and confirmation.

4.3 Payment Terms.

4.3.1 Agency shall pay CSX for Reimbursable Expenses in the amounts and on the dates set forth in the Payment Schedule as shown on Exhibit E (the "Payment Schedule", as revised pursuant to Section 4.2). CSX agrees to submit invoices to Agency for such amounts and Agency shall remit payment to CSX at the later of thirty (30) days following delivery of each such invoice to Agency or, the payment date (if any) set forth in the Payment Schedule.

4.3.2 Following completion of the Project, CSX shall submit to Agency a final invoice that reconciles the total Reimbursable Expenses incurred by CSX against the total payments received from Agency. Agency shall pay to CSX the amount by which Reimbursable Expenses exceed total payments as shown by the final invoice, within thirty (30) days following delivery of such invoice to Agency. In the event that the payments received by CSX from Agency exceed the Reimbursable Expenses, CSX shall remit such excess to Agency.

4.3.3 In the event that Agency fails to pay CSX any sums due CSX under this Agreement: (i) Agency shall pay CSX interest at the lesser of 1.0% per month or the maximum rate of interest permitted by applicable law on the delinquent amount until paid in full; and (ii) CSX may elect, by delivery of notice to Agency: (A) to immediately cease all further work on the Project, unless and until Agency pays the entire delinquent sum, together with accrued interest; and/or (B) to terminate this Agreement.

4.3.4 All invoices from CSX shall be delivered to Agency in accordance with Section 16 of this Agreement. All payments by Agency to CSX shall be made by certified check and mailed to the following address or such other address as designated by CSX's notice to Agency:

CSX Transportation, Inc.
P.O. Box 530192
Atlanta, GA 30353-0192

4.4 Effect of Termination. Agency's obligation to pay to CSX Reimbursable Expenses in accordance with Section 4 shall survive termination of this Agreement for any reason.

5. Appropriations Agency represents to CSX that: (i) Agency has appropriated funds sufficient to reimburse CSX for the Reimbursable Expenses encompassed by the Estimate attached as Exhibit D; (ii) Agency shall use its best efforts to obtain appropriations necessary to cover Reimbursable Expenses encompassed by subsequent Estimates approved by Agency; and (iii) Agency shall promptly notify CSX in the event that Agency is unable to obtain such appropriations.

6. Easements and Licenses

6.1 Agency Obligation. Agency shall acquire all necessary licenses, permits and easements required for the Project.

6.2 Temporary Construction Licenses. Insofar as it has the right to do so, CSX hereby grants Agency a nonexclusive license to access and cross CSX's property, to the extent necessary for the construction of the Project (excluding ingress or egress over public grade crossings), along such routes and upon such terms as may be defined and imposed by CSX and such temporary construction easements as may be designated on the Plans approved by CSX.

6.3 Temporary Construction Easements. CSXT may grant without warranty to Agency, if required, a temporary non-exclusive easement for access to the extent necessary for the project on terms and conditions and at a price acceptable to the parties.

6.4 Maintenance Agreement. Contemporaneous with the execution of this Agreement, CSXT and Agency have executed that certain Maintenance Agreement providing for Agency's ongoing use maintenance, repair, renewal and removal of the Project.

6.5 Permanent Easements. Insofar as it has the right to do so, CSXT shall grant, without warranty to Agency, easements for the use and maintenance (in accordance with the provisions of the Maintenance Agreement described in 6.4) of the Project wholly or partly on CSXT property as shown on the Plans approved by CSXT, if any, on terms and conditions and at a price acceptable to both parties. Upon request by CSXT, Agency shall furnish to CSXT descriptions and plat plans for the easements.

7. Permits At its sole cost and expense, Agency shall procure all permits and approvals required by any federal, state, or local governments or governmental agencies for the construction, maintenance and use of the Project, copies of which shall be provided to CSX.

8. Termination

8.1 By Agency. For any reason, Agency may, as its sole remedy, terminate this Agreement by delivery of notice to CSX. Agency shall not be entitled to otherwise pursue claims for consequential, direct, indirect or incidental damages or lost profits as a consequence of CSX's default or termination of this Agreement or Work on the Project by either party.

8.2 By CSX. In addition to the other rights and remedies available to CSX under this Agreement, CSX may terminate this Agreement by delivery of notice to Agency in the event Agency or its Contractors fail to observe the terms or conditions of this Agreement and such failure continues more than ten (10) business days following delivery of notice of such failure by CSX to Agency.

8.3 Consequences of Termination. If the Agreement is terminated by either party pursuant to this Section or any other provision of this Agreement, the parties understand that it may be impractical for them to immediately stop the Work. Accordingly, they agree that, in such instance a party may continue to perform Work until it has reached a point where it may reasonably and safely suspend the Work. Agency shall reimburse CSX pursuant to this Agreement for the Work performed, plus all costs reasonably incurred by CSX to discontinue the Work and protect the Work upon full suspension of the same, the cost of returning CSX's property to its former condition, and all other costs of CSX incurred as a result of the Project up to the time of full suspension of the Work. Termination of this Agreement or Work on the Project, for any reason, shall not diminish or reduce Agency's obligation to pay CSX for Reimbursable Expenses incurred in accordance with this Agreement. In the event of the termination of this Agreement or the Work for any reason, CSX's only remaining obligation to Agency shall be to refund to Agency payments made to CSX in excess of Reimbursable Expenses in accordance with Section 4.

9. Insurance In addition to the insurance that Agency requires of its Contractor, Agency shall acquire or require its Contractor to purchase and maintain insurance in compliance with CSX's insurance requirements attached to this Agreement as Exhibit F. Neither Agency nor Contractor shall commence work on the Project until such policy or policies have been submitted to and approved by CSX's Risk Management Department.

10. Ownership and Maintenance

[SELECT ONE OF THE FOLLOWING ALTERNATE PROVISIONS:]

- Railroad Bridge

10.1 By Agency. Agency shall own and, without cost to CSX, shall maintain, repair, replace and renew, or cause same to be done, in good condition and repair to CSX's satisfaction, the railroad bridge structure (excluding only those components which CSX owns and has agreed to maintain, repair and replace pursuant to this Section), the highway underpass structure, the roadway surfacing, the roadway slopes, the retaining walls, the roadway drainage facilities, sidewalks and lighting. In the event that Agency fails to properly maintain such structures and improvements, and such failure, in the opinion of CSX, jeopardizes the safe and efficient operation of its property, CSX shall be entitled to remedy such failure and recover from Agency the costs incurred by CSX in doing so.

10.2 By CSX. CSX shall own and, at its sole cost and expense, maintain, repair, replace and renew its tracks, ballast and approach embankments, and railroad signal and communication systems, and CSX shall be permitted to install, maintain, repair and replace other utilities, facilities and cable, or cause same to be done, as CSX authorizes from time to time on or within the railroad bridge structure.

10.3 Alterations. Agency shall not undertake any alteration, modification or expansion of the Project, without the prior approval of CSX, which may be withheld for any reason, and the execution of such agreements as CSX may require. CSX may effectuate any improvements to that portion of the Project on which CSX operates its rail line, without securing the prior approval of the Agency so long as such improvements will not have a negative impact on highway traffic using the highway underpass.

- Highway Bridge

10.1 By Agency. Agency shall own and, without cost to CSX, maintain, repair, replace and renew, or cause same to be done, in good condition and repair to CSX's satisfaction, the highway overpass structure, the roadway surfacing, the roadway slopes, the retaining walls, and the highway drainage facilities. In the event that Agency fails to properly maintain such structures and improvements and such failure, in the opinion of CSX, jeopardizes the safe and efficient operation of its property, CSX shall be entitled to remedy such failure and recover from Agency the costs incurred by CSX in doing so. Upon the cessation of use of the Project by Agency, Agency shall remove the bridge structure and restore CSX's property to its original condition, at Agency's sole cost and expense, to CSX's satisfaction.

10.2 Alterations. Agency shall not undertake any alteration, modification or expansion of the Project, without the prior approval of CSX, which may be withheld for any reason, and the execution of such agreements as CSX may require.

- At Grade Crossings

10.1 By Agency. Agency shall maintain and repair, at its sole cost and expense, all parts comprising the permanent aspects of the Project, as shown by the Plans, consisting of roadway pavement up to the outer ends of the railroad cross ties, sidewalks, guardrails, and curbs, in good and safe condition to CSX's satisfaction. In the event Agency fails to do so after reasonable notice from CSX (unless an emergency condition exists or is imminent in the opinion of CSX that requires immediate action), CSX may perform such maintenance and repair, at Agency's sole cost and expense.

10.2 By CSX. CSX shall maintain and repair the crossing surface between the ends of its cross ties and its signal facilities at the crossing, at Agency's sole cost and expense.

10.3 Alterations. Agency shall not undertake any alteration, modification or expansion of the Project, without the prior written approval of CSX, which may be withheld for any reason, and the execution of such agreements as CSX may require. CSX may undertake alterations of its property, track or facilities and shall be reimbursed by Agency for the expenses incurred by CSX with respect to the removal and restoration of the crossing in connections with such alteration.

- Other Improvements

10.1 By Agency. Agency shall own, maintain and repair, at its sole cost and expense, all parts comprising the permanent aspects of the Project, as shown by the Plans. In the event Agency fails to do so after reasonable notice from CSX (no more than thirty (30) days, unless an emergency condition exists or is imminent in the opinion of CSX, that requires immediate action), CSX may perform such maintenance and repair, at Agency's sole cost and expense. Upon the cessation of use of the Project by Agency, Agency shall remove the structure and restore CSX's property to its original condition, at Agency's sole cost and expense, to CSX's satisfaction.

10.2 Alterations. Agency shall not undertake any alteration, modification or expansion of the Project, without the prior approval of CSX, which may be withheld for any reason, and the execution of such agreements as CSX may require.

11. Indemnification

11.1 Generally. To the maximum extent permitted by applicable law, Agency and its Contractors shall indemnify, defend, and hold CSX and its affiliates harmless from and against all claims, demands, payments, suits, actions, judgments, settlements, and damages of every nature, degree, and kind (including direct, indirect, consequential, incidental, and punitive damages), for any injury to or death to any person(s) (including, but not limited to the employees of CSX, its affiliates, Agency or its Contractors), for the loss of or damage to any property whatsoever (including but not limited to property owned by or in the care, custody, or control of CSX, its affiliates, Agency or its Contractors, and environmental damages and any related remediation brought or recovered against CSX and its affiliates), arising directly or indirectly from the negligence, recklessness or intentional wrongful misconduct of the Contractors, Agency, and their respective agents, employees, invitees, contractors, or its contractors' agents, employees or invitees in the performance of work in connection with the Project or activities incidental thereto, or from their presence on or about CSX's property. The foregoing indemnification obligation shall not be limited to the insurance coverage required by this Agreement, except to the extent required by law or otherwise expressly provided by this Agreement.

11.2 Compliance with Laws. Agency shall comply, and shall require its Contractors to comply, with any federal, state, or local laws, statutes, codes, ordinances, rules, and regulations applicable to its construction and maintenance of the Project. Agency's Contractors shall indemnify, defend, and hold CSX and its affiliates harmless with respect to any fines, penalties, liabilities, or other consequences arising from breaches of this Section.

11.3 "CSX Affiliates". For the purpose of this Section 11, CSX's affiliates include CSX Corporation and all entities, directly or indirectly, owned or controlled by or under common control of CSX or CSX Corporation and their respective officers, directors, employees and agents.

11.4 Notice of Incidents. Agency and its Contractor shall notify CSX promptly of any loss, damage, injury or death arising out of or in connection with the Project work.

11.5 Survival. The provisions of this Section 11 shall survive the termination or expiration of this Agreement.

12. Independent Contractor The parties agree that neither Agency nor its Contractors shall be deemed either agents or independent contractors of CSX. Except as otherwise provided by this Agreement, CSX shall exercise no control whatsoever over the employment, discharge, compensation of, or services rendered by Agency or Agency's Contractors, or the construction practices, procedures, and professional judgment employed by Agency or its Contractor to complete the Project. Notwithstanding the foregoing, this Section 12 shall in no way affect the absolute authority of CSX to prohibit Agency or its Contractors or anyone from entering CSX's property, or to require the removal of any person from its property, if it determines,

in its sole discretion, that such person is not acting in a safe manner or that actual or potential hazards in, on or about the Project exist.

13. "Entire Agreement" This Agreement embodies the entire understanding of the parties, may not be waived or modified except in a writing signed by authorized representatives of both parties, and supersedes all prior or contemporaneous written or oral understandings, agreements or negotiations regarding its subject matter. In the event of any inconsistency between this Agreement and the Exhibits, the more specific terms of the Exhibits shall be deemed controlling.

14. Waiver If either party fails to enforce its respective rights under this Agreement, or fails to insist upon the performance of the other party's obligations hereunder, such failure shall not be construed as a permanent waiver of any rights or obligations in this Agreement.

15. Assignment CSX may assign this Agreement and all rights and obligations herein to a successor in interest, parent company, affiliate, or future affiliate. Upon assignment of this Agreement by CSX and the assumption of CSX's assignee of CSX's obligations under this Agreement, CSX shall have no further obligation under this Agreement. Agency shall not assign its rights or obligations under this Agreement without CSX's prior consent, which consent may be withheld for any reason.

16. Notices All notices, consents and approvals required or permitted by this Agreement shall be in writing and shall be deemed delivered upon personal delivery, upon the expiration of three (3) days following mailing by first class U.S. mail, or upon the next business day following mailing by a nationally recognized overnight carrier, to the parties at the addresses set forth below, or such other addresses as either party may designate by delivery of prior notice to the other party:

If to CSX: CSX Transportation, Inc.
500 Water Street, J301 Jacksonville, Florida 32202
Attention: Director Project Management – Public Projects

If to Agency: _____

17. Severability The parties agree that if any part, term or provision of this Agreement is held to be illegal, unenforceable or in conflict with any applicable federal, state, or local law or regulation, such part, term or provision shall be severable, with the remainder of the Agreement remaining valid and enforceable.

18. Applicable Law This Agreement shall be governed by the laws of the State of [INSERT STATE OF PROJECT LOCATION], exclusive of its choice of law rules. The parties further agree that the venue of all legal and equitable proceedings related to disputes under this Agreement shall be situated in Duval County, Florida, and the parties agree to submit to the personal jurisdiction of any State or Federal court situated in Duval County, Florida.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed in duplicate, each by its duly authorized officers, as of the date of this Agreement.

[INSERT NAME OF AGENCY]

By: _____

Print Name: _____

Title: _____

CSX TRANSPORTATION, INC.

By: _____

Tony C. Bellamy, P.E.

Director Project Management-Public Projects

EXHIBIT A
ALLOCATION OF WORK

Subject to Section 2.1, work to be performed in connection with the Project is allocated as follows:

A. Agency shall let by contract to its Contractors:

1. [INSERT DESCRIPTION OF WORK]

B. CSX shall perform or cause to be performed:

1. Preliminary engineering services.
2. Changes in communication and signal lines.
3. Flagging services and other protective services and devices as may be necessary.
4. Construction engineering and inspection to protect the interests of CSX.

**EXHIBIT B
PLANS AND SPECIFICATIONS**

Plans, Specifications and Drawings:

As of the date of this Agreement, the following plans, specifications and drawings have been submitted by Agency to CSX for its review and approval:

[IDENTIFY PLANS AND SPECIFICATIONS BY DATE, PREPARER, TITLE, PROJECT NUMBER, ETC.]

| SHEET | DESCRIPTION | PREPARER | DATE |
|-------|-------------|----------|------|
| 1 of | | | |

EXHIBIT C

CSX SPECIAL PROVISIONS

DEFINITIONS:

As used in these Special Provisions, all capitalized terms shall have the meanings ascribed to them by the Agreement, and the following terms shall have the meanings ascribed to them below:

“CSX” shall mean CSX Transportation, Inc., its successors and assigns.

“CSX Representative” shall mean the authorized representative of CSX Transportation, Inc.

“Agreement” shall mean the Agreement between CSX and Agency, as amended from time to time.

“Agency” shall mean the [INSERT NAME OF AGENCY].

“Agency Representative” shall mean the authorized representative of [INSERT NAME OF AGENCY].

“Contractor” shall have the meaning ascribed to such term by the Agreement.

“Work” shall mean the Project as described in the Agreement.

I. AUTHORITY OF CSX ENGINEER

The CSX Representative shall have final authority in all matters affecting the safe maintenance of CSX operations and CSX property, and his or her approval shall be obtained by the Agency or its Contractor for methods of construction to avoid interference with CSX operations and CSX property and all other matters contemplated by the Agreement and these Special Provisions.

II. INTERFERENCE WITH CSX OPERATIONS

A. Agency or its Contractor shall arrange and conduct its work so that there will be no interference with CSX operations, including train, signal, telephone and telegraphic services, or damage to CSX's property, or to poles, wires, and other facilities of tenants on CSX's Property or right-of-way. Agency or its Contractor shall store materials so as to prevent trespassers from causing damage to trains, or CSX Property. Whenever Work is likely to affect the operations or safety of trains, the method of doing such Work shall first be submitted to the CSX Representative for approval, but such approval shall not relieve Agency or its Contractor from liability in connection with such Work.

B. If conditions arising from or in connection with the Project require that immediate and unusual provisions be made to protect train operation or CSX's property, Agency or its Contractor shall make such provision. If the CSX Representative determines that such provision is insufficient, CSX may, at the expense of Agency or its Contractor, require or provide such provision as may be deemed necessary, or cause the Work to cease immediately.

III. NOTICE OF STARTING WORK. Agency or its Contractor shall not commence any work on CSX Property or rights-of-way until it has complied with the following conditions:

A. Notify CSX in writing of the date that it intends to commence Work on the Project. Such notice must be received by CSX at least ten business days in advance of the date Agency or its Contractor proposes to begin Work on CSX property. The notice must refer to this Agreement by date. If flagging service is required, such notice shall be submitted at least thirty (30) business days in advance of the date scheduled to commence the Work.

B. Obtain authorization from the CSX Representative to begin Work on CSX property, such authorization to include an outline of specific conditions with which it must comply.

C. Obtain from CSX the names, addresses and telephone numbers of CSX's personnel who must receive notice under provisions in the Agreement. Where more than one individual is designated, the area of responsibility of each shall be specified.

IV. WORK FOR THE BENEFIT OF THE CONTRACTOR

A. No temporary or permanent changes to wire lines or other facilities (other than third party fiber optic cable transmission systems) on CSX property that are considered necessary to the Work are anticipated or shown on the Plans. If any such changes are, or become, necessary in the opinion of CSX or Agency, such changes will be covered by appropriate revisions to the Plans and by preparation of a force account estimate. Such force account estimate may be initiated by either CSX or Agency, but must be approved by both CSX and Agency. Agency or Contractor shall be responsible for arranging for the relocation of the third party fiber optic cable transmission systems, at no cost or expense to CSX.

B. Should Agency or Contractor desire any changes in addition to the above, then it shall make separate arrangements with CSX for such changes to be accomplished at the Agency or Contractor's expense.

V. HAUL ACROSS RAILROAD

A. If Agency or Contractor desires access across CSX property or tracks at other than an existing and open public road crossing in or incident to construction of the Project, the Agency or Contractor must first obtain the permission of CSX and shall execute a license agreement or right of entry satisfactory to CSX, wherein Agency or Contractor agrees to bear all costs and liabilities related to such access.

B. Agency and Contractor shall not cross CSX's property and tracks with vehicles or equipment of any kind or character, except at such crossing or crossings as may be permitted pursuant to this section.

VI. COOPERATION AND DELAYS

A. Agency or Contractor shall arrange a schedule with CSX for accomplishing stage construction involving work by CSX. In arranging its schedule, Agency or Contractor shall ascertain, from CSX, the lead time required for assembling crews and materials and shall make due allowance therefore.

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B. Agency or Contractor may not charge any costs or submit any claims against CSX for hindrance or delay caused by railroad traffic; work done by CSX or other delay incident to or necessary for safe maintenance of railroad traffic; or for any delays due to compliance with these Special Provisions.

C. Agency and Contractor shall cooperate with others participating in the construction of the Project to the end that all work may be carried on to the best advantage.

D. Agency and Contractor understand and agree that CSX does not assume any responsibility for work performed by others in connection the Project. Agency and Contractor further understand and agree that they shall have no claim whatsoever against CSX for any inconvenience, delay or additional cost incurred by Agency or Contractor on account of operations by others.

VII. STORAGE OF MATERIALS AND EQUIPMENT

Agency and Contractor shall not store their materials or equipment on CSX's property or where they may potentially interfere with CSX's operations, unless Agency or Contractor has received CSX Representative's prior written permission. Agency and Contractor understand and agree that CSX will not be liable for any damage to such materials and equipment from any cause and that CSX may move, or require Agency or Contractor to move, such material and equipment at Agency's or Contractor's sole expense. To minimize the possibility of damage to the railroad tracks resulting from the unauthorized use of equipment, all grading or other construction equipment that is left parked near the tracks unattended by watchmen shall be immobilized to the extent feasible so that it cannot be moved by unauthorized persons.

VIII. CONSTRUCTION PROCEDURES

A. General

1. Construction work on CSX property shall be subject to CSX's inspection and approval.
2. Construction work on CSX property shall be in accord with CSX's written outline of specific conditions and with these Special Provisions.
3. Contractor shall observe the terms and rules of the CSX Safe Way manual, which Agency and Contractor shall be required to obtain from CSX, and in accord with any other instructions furnished by CSX or CSX's Representative.

B. Blasting

1. Agency or Contractor shall obtain CSX Representative's and Agency Representative's prior written approval for use of explosives on or adjacent to CSX property. If permission for use of explosives is granted, Agency or Contractor must comply with the following:
 - a. Blasting shall be done with light charges under the direct supervision of a responsible officer or employee of Agency or Contractor.
 - b. Electric detonating fuses shall not be used because of the possibility of premature explosions resulting from operation of two-way train radios.
 - c. No blasting shall be done without the presence of an authorized representative of CSX. At least 30 days' advance notice to CSX Representative is required to arrange for the presence of an authorized CSX representative and any flagging that CSX may require.

d. Agency or Contractor must have at the Project site adequate equipment, labor and materials, and allow sufficient time, to (i) clean up (at Agency's expense) debris resulting from the blasting without any delay to trains; and (ii) correct (at Agency's expense) any track misalignment or other damage to CSX's property resulting from the blasting, as directed by CSX Representative, without delay to trains. If Agency's or Contractor's actions result in delay of any trains, including Amtrak passenger trains, Agency shall bear the entire cost thereof.

e. Agency and Contractor shall not store explosives on CSX property.

2. CSX Representative will:

a. Determine the approximate location of trains and advise Agency or Contractor of the approximate amount of time available for the blasting operation and clean-up.

b. Have the authority to order discontinuance of blasting if, in his or her opinion, blasting is too hazardous or is not in accord with these Special Provisions.

IX. MAINTENANCE OF DITCHES ADJACENT TO CSX TRACKS

Agency or Contractor shall maintain all ditches and drainage structures free of silt or other obstructions that may result from their operations. Agency or Contractor shall provide erosion control measures during construction and use methods that accord with applicable state standard specifications for road and bridge construction, including either

(1) silt fence; (2) hay or straw barrier; (3) berm or temporary ditches; (4) sediment basin; (5) aggregate checks; and (6) channel lining. All such maintenance and repair of damages due to Agency's or Contractor's operations shall be performed at Agency's expense.

X. FLAGGING / INSPECTION SERVICE

A. CSX has sole authority to determine the need for flagging required to protect its operations and property. In general, flagging protection will be required whenever Agency or Contractor or their equipment are, or are likely to be, working within fifty (50) feet of live track or other track clearances specified by CSX, or over tracks.

B. Agency shall reimburse CSX directly for all costs of flagging that is required on account of construction within CSX property shown in the Plans, or that is covered by an approved plan revision, supplemental agreement or change order.

C. Agency or Contractor shall give a minimum of 10 days' advance notice to CSX Representative for anticipated need for flagging service. No work shall be undertaken until the flag person(s) is/are at the job site. If it is necessary for CSX to advertise a flagging job for bid, it may take up to 90-days to obtain this service, and CSX shall not be liable for the cost of delays attributable to obtaining such service.

D. CSX shall have the right to assign an individual to the site of the Project to perform inspection service whenever, in the opinion of CSX Representative, such inspection may be necessary. Agency shall reimburse CSX for the costs incurred by CSX for such inspection service. Inspection service shall not relieve Agency or Contractor from liability for its Work.

E. CSX shall render invoices for, and Agency shall pay for, the actual pay rate of the flagpersons and inspectors used, plus standard additives, whether that amount is above or below the rate provided in the Estimate. If the rate of pay that is to be used for inspector or flagging service is changed before the work is started or during the progress of the work, whether by law or agreement between CSX and its employees, or if the tax rates on labor are changed, bills will be rendered by CSX and paid by Agency using the new rates. Agency and Contractor shall perform their operations that require flagging protection or inspection service in such a manner and sequence that the cost of such will be as economical as possible.

XI. UTILITY FACILITIES ON CSX PROPERTY

Agency shall arrange, upon approval from CSX, to have any utility facilities on or over CSX Property changed as may be necessary to provide clearances for the proposed trackage.

XII. CLEAN-UP

Agency or Contractor, upon completion of the Project, shall remove from CSX's Property any temporary grade crossings, any temporary erosion control measures used to control drainage, all machinery, equipment, surplus materials, falsework, rubbish, or temporary buildings belonging to Agency or Contractor. Agency or Contractor, upon completion of the Project, shall leave CSX Property in neat condition, satisfactory to CSX Representative.

XIII. FAILURE TO COMPLY

If Agency or Contractor violate or fail to comply with any of the requirements of these Special Provisions, (a) CSX may require Agency and/or Contractor to vacate CSX Property; and (b) CSX may withhold monies due Agency and/or Contractor; (c) CSX may require Agency to withhold monies due Contractor; and (d) CSX may cure such failure and the Agency shall reimburse CSX for the cost of curing such failure.

EXHIBIT D
INITIAL ESTIMATE ATTACHED

EXHIBIT E
PAYMENT SCHEDULE

[SELECT ONE OF FOLLOWING ALTERNATE PROVISIONS:]

Advance Payment in Full

Upon execution and delivery of notice to proceed with the Project, Agency will deposit with CSX a sum equal to the Reimbursable Expenses, as shown by the Estimate. If CSX anticipates that it may incur Reimbursable Expenses in excess of the deposited amount, CSX will request an additional deposit equal to the then remaining Reimbursable Expenses which CSX estimates that it will incur. CSX shall request such additional deposit by delivery of invoices to Agency. Agency shall make such additional deposit within 30 days following delivery of such invoice to Agency.

50/50 Payment in Advance

Upon delivery of notice to proceed with the Project, Agency will deposit with CSX a sum equal to fifty percent (50%) of the Reimbursable Expenses as shown by the Estimate. Prior to the incurrence of Reimbursable Expenses in excess of such deposit, CSX will request an additional deposit equal to the Reimbursable Expenses which CSX expects to incur. CSX shall request such additional deposit by delivery of invoices to Agency. Agency shall make such additional deposits within 30 days following delivery of such invoice to Agency.

Scheduled Payments

Agency shall deposit with CSX the following sums on or before the dates set forth below, which sums and dates shall be subject to adjustment in the event of revisions to the Estimate:

| | |
|---------------|----------|
| Payment Date: | Payment: |
| _____ | _____ |
| | Total: |
| | _____ |

Progress Payments In Arrears

Notwithstanding anything to the contrary set forth in this Agreement, Agency shall pay CSX in arrears for its Reimbursable Expenses, rather than in advance, with only such exceptions, such as purchasing materials and equipment, as the parties mutually agree. Accordingly, Agency shall remit payment to CSX for its Reimbursable Expenses within thirty (30) days following delivery to Agency of an invoice.

EXHIBIT F INSURANCE REQUIREMENTS

I. Insurance Policies

Agency and Contractor, if and to the extent that either is performing work on or about CSX's property, shall procure and maintain the following insurance policies:

1. Commercial General Liability coverage at their sole cost and expense with limits of not less than \$5,000,000 in combined single limits for bodily injury and/or property damage per occurrence, and such policies shall name CSX as an additional named insured.
2. Statutory Worker's Compensation and Employers Liability Insurance with limits of not less than \$1,000,000, which insurance must contain a waiver of subrogation against CSX and its affiliates (if permitted by state law).
3. Commercial automobile liability insurance with limits of not less than \$1,000,000 combined single limit for bodily injury and/or property damage per occurrence, and such policies shall name CSX as an additional named insured.
4. Railroad protective liability insurance with limits of not less than \$5,000,000 combined single limit for bodily injury and/or property damage per occurrence and an aggregate annual limit of \$10,000,000, which insurance shall satisfy the following additional requirements:
 - a. The Railroad Protective Insurance Policy must be on the ISO/RIMA Form of Railroad Protective Insurance - Insurance Services Office (ISO) Form CG 00 35.
 - b. CSX Transportation must be the named insured on the Railroad Protective Insurance Policy.
 - c. Name and Address of Contractor and Agency must appear on the Declarations page.
 - d. Description of operations must appear on the Declarations page and must match the Project description.
 - e. Authorized endorsements must include the Pollution Exclusion Amendment - CG 28 31, unless using form CG 00 35 version 96 and later.
 - f. Authorized endorsements may include:
 - (i). Broad Form Nuclear Exclusion - IL 00 21
 - (ii) 30-day Advance Notice of Non-renewal or cancellation
 - (iii) Required State Cancellation Endorsement
 - (iv) Quick Reference or Index - CL/IL 240
 - g. Authorized endorsements may not include:
 - (i) A Pollution Exclusion Endorsement except CG 28 31
 - (ii) A Punitive or Exemplary Damages Exclusion
 - (iii) A "Common Policy Conditions" Endorsement
 - (iv) Any endorsement that is not named in Section 4 (e) or (f) above.
 - (v) Policies that contain any type of deductible

5. All insurance companies must be A. M. Best rated A- and Class VII or better.
6. The CSX OP number or CSX contract number, as applicable, must appear on each Declarations page and/or certificates of insurance.
7. Such additional or different insurance as CSX may require.

II. Additional Terms

1. Contractor must submit the complete Railroad Protective Liability policy, Certificates of Insurance and all notices and correspondence regarding the insurance policies in an electronic format to:

Insurance Department
CSX Transportation, Inc.
500 Water Street, C-907
Jacksonville, FL 32202

OR

insurancedocuments@csx.com

2. Neither Agency nor its Designee may begin work on or about CSX property until written approval of the required insurance has been received from CSX or CSX's Insurance Compliance vendor, Ebix.

SCHEDULE I
CONTRACTOR'S ACCEPTANCE

To and for the benefit of CSX Transportation, Inc. ("CSX") and to induce CSX to permit Contractor on or about CSX's property for the purposes of performing work in accordance with the Agreement dated _____, 201____, between [INSERT NAME OF AGENCY] and CSX, Contractor hereby agrees to abide by and perform all applicable terms of the Agreement, including, but not limited to Exhibits C and F to the Agreement, and Sections 3, 9 and 11 of the Agreement.

Contractor: _____

By: _____

Name _____

Title: _____

Date: _____

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**APPENDIX B -
CSXT CONSTRUCTION
SUBMISSION CRITERIA**

APPENDIX

CSX TRANSPORTATION

CONSTRUCTION SUBMISSION CRITERIA

INTRODUCTION

SECTION I: Definitions

SECTION II: Construction Submissions

SECTION III: Hoisting Operations

SECTION IV: Demolition Procedure

SECTION V: Erection Procedure

SECTION VI: Temporary Excavation and Shoring

SECTION VII: Track Monitoring

INTRODUCTION

The intent of this document is to guide outside agencies and their Contractors when performing work on, over, or with potential to impact CSX property (ROW). Work plans shall be submitted for review to the designated CSX Engineering Representative for all work which presents the potential to affect CSX property or operations; this document shall serve as a guide in preparing these work plans. All work shall be performed in a manner that does not adversely impact CSX operations or safety; as such, the requirements of this document shall be strictly adhered to, in addition to all other applicable standards associated with the construction. Applicable standards include, but are not limited to, CSX Standards and Special Provisions, CSX Insurance Requirements, CSX Pipeline Occupancy Criteria, as well as the governing local, county, state and federal requirements. It shall be noted that this document and all other CSX standards are subject to change without notice, and future revisions will be made available at the CSX website: www.csx.com.

I. DEFINITIONS

1. Agency – The project sponsor (i.e., State DOT, Local Agencies, Private Developer, etc.)
2. AREMA – American Railway Engineering and Maintenance-of-Way Association – the North American railroad industry standards group. The use of this term shall be in specific reference to the AREMA Manual for Railway Engineering.
3. Construction Submission – The Agency or its representative shall submit six (6) sets of plans, supporting calculations, and detailed means and methods procedures for the specific proposed activity. All plans, specifications, and supporting calculations shall be signed/sealed by a Professional Engineer as defined below.
4. Controlled Demolition – Removal of an existing structure or subcomponents in a manner that positively prevents any debris or material from falling, impacting, or otherwise affecting CSX employees, equipment or property. Provisions shall be made to ensure that there is no impairment of railroad operations or CSX’s ability to access its property at all times.
5. Contractor – The Agency’s representative retained to perform the project work.
6. Engineer – CSX Engineering Representative or a GEC authorized to act on the behalf of CSX.
7. Flagman – A qualified CSX employee with the sole responsibility to direct or restrict movement of trains, at or through a specific location, to provide protection for workers.
8. GEC – General Engineering Consultant who has been authorized to act on the behalf of CSX.
9. Horizontal Clearance – Distance measured perpendicularly from centerline of any track to the nearest obstruction at any elevation between TOR and the maximum vertical clearance of the track.
10. Professional Engineer – An engineer who is licensed in State or Commonwealth in which the project is to occur. All plans, specifications, and supporting calculations shall be prepared by the Licensed Professional Engineer and shall bear his/her seal and signature.
11. Potential to Foul – Work having the possibility of impacting CSX property or operations; defined as one or more of the following:
 - a. Any activity where access onto CSX property is required.

b. Any activity where work is being performed on CSX ROW.

c. Any excavation work adjacent to CSX tracks or facilities, within the Theoretical Railroad Live Load Influence Zone, or where the active earth pressure zone extends within the CSX property limits.

d. The use of any equipment where, if tipped and laid flat in any direction (360 degrees) about its center pin, can encroach within twenty five feet (25'-0") of the nearest track centerline. This is based upon the proposed location of the equipment during use, and may be a function of the equipment boom length. Note that hoisting equipment with the potential to foul must satisfy the 150% factor of safety requirement for lifting capacities.

e. Any work where the scatter of debris, or other materials has the potential to encroach within twenty five feet (25'-0") of the nearest track centerline.

f. Any work where significant vibration forces may be induced upon the track structure or existing structures located under, over, or adjacent to the track structure.

g. Any other work which poses the potential to disrupt rail operations, threaten the safety of railroad employees, or otherwise negatively impact railroad property, as determined by CSX.

12. ROW – Right of Way; Refers to CSX Right-of-Way as well as all CSX property and facilities. This includes all aerial space within the property limits, and any underground facilities.

13. Submission Review Period - a minimum of thirty (30) days in advance of start of work. Up to thirty (30) days will be required for the initial review response. Up to an additional thirty (30) days may be required to review any/all subsequent submissions or resubmission.

14. Theoretical Railroad Live Load Influence Zone – A 1 horizontal to 1 vertical theoretical slope line starting at bottom corner of tie.

15. TOR – Top of Rail. This is the base point for clearance measurements. It refers to the crown (top) of the steel rail; the point where train wheels bear on the steel rails.

16. Track Structure – All load bearing elements which support the train. This includes, but is not limited to, the rail, ties, appurtenances, ballast, sub-ballast, embankment, retaining walls, and bridge structures.

17. Vertical Clearance – Distance measured from TOR to the lowest obstruction within six feet (6'-0") of the track centerline, in either direction.

II. GENERAL SUBMISSION REQUIREMENTS

A. A construction work plan is required to be submitted by the Agency or its Contractor, for review and acceptance, prior to accessing or performing any work with Potential to Foul.

B. The Agency or its representative shall submit six (6) sets of plans, specifications, supporting calculations, and detailed means and methods procedures for the specific proposed work activity.

C. Construction submissions shall include all information relevant to the work activity, and shall clearly and concisely explain the nature of the work, how it is being performed, and what measures are being taken to ensure that railroad property and operations are continuously maintained.

D. All construction plans shall include a map of the work site, depicting the CSX tracks, the CSX right of way, proposed means of access, proposed locations for equipment and material staging (dimensioned from nearest track centerline), as well as all other relevant project information. An elevation drawing may also be necessary in order to depict clearances or other components of the work.

E. Please note that CSX will not provide pricing to individual contractors involved in bidding projects. Bidding contractors shall request information from the agency and not CSX.

F. The Contractor shall install a geotextile fabric ballast protection system to prevent construction or demolition debris and fines from fouling ballast. The geotextile ballast protection system shall be installed and maintained by the Contractor to the satisfaction of the Engineer.

G. The Engineer shall be kept aware of the construction schedule. The Contractor shall provide timely communication to the Engineer when scheduling the work such that the Engineer may be present during the work. The Contractor's schedule shall not dictate the work plan review schedule, and flagging shall not be scheduled prior to receipt of an accepted work plan.

H. At any time during construction activities, the Engineer may require revisions to the previously approved procedures to address weather, site conditions or other circumstances that may create a potential hazard to rail operations or CSX facilities. Such revisions may require immediate interruption or termination of ongoing activities until such time the issue is resolved to the Engineer's satisfaction. CSX and its GEC shall not be responsible for any additional costs or time claims associated with such revisions.

I. Blasting will not be permitted to demolish a structure over or within CSX's right-of-way. When blasting off of CSX property but with Potential to Foul, vibration monitoring, track settlement surveying, and/or other protective measures may be required as determined by the Engineer.

J. Blasting is not permitted adjacent to CSX right-of-way without written approval from the Chief Engineer, CSX.

K. Mechanical and chemical means of rock removal must be explored before blasting is considered. If written permission for the use of explosives is granted, the Agency or Contractor must submit a work plan satisfying the following requirements:

1. Blasting shall be done with light charges under the direct supervision of a responsible officer or employee of the Agency or Contractor.

2. Electronic detonating fuses shall not be used because of the possibility of premature explosions resulting from operation of two-way train radios.

3. No blasting shall be done without the presence of an authorized representative of CSX. Advance notice to the Engineer is required to arrange for the presence of an authorized CSX representative and any flagging that CSX may require.

4. Agency or Contractor must have at the project site adequate equipment, labor and materials, and allow sufficient time, to clean up debris resulting from the blasting and correct any misalignment of tracks or other damage to CSX property resulting from the blasting. Any corrective measures required must be performed as directed by the Engineer at the Agency's or Contractor's expense without any delay to trains. If Agency's or Contractor's actions result in the delay of any trains including passenger trains, the Agency or Contractor shall bear the entire cost thereof.

5. The Agency or Contractor may not store explosives on CSX property.

6. At any time during blasting activities, the Engineer may require revisions to the previously approved procedures to address weather, site conditions or other circumstances that may create a potential hazard to rail operations or CSX facilities. Such revisions may require immediate interruption or termination of ongoing activities until such time the issue is resolved to the Engineer's satisfaction. CSX and its GEC shall not be responsible for any additional costs or time claims associated with such revisions.

III. HOISTING OPERATIONS

A. All proposed hoisting operations with Potential to Foul shall be submitted in accordance with the following:

1. A plan view drawing shall depict the work site, the CSX track(s), the proposed location(s) of the lifting equipment, as well as the proposed locations for picking, any intermediate staging, and setting the load(s). All locations shall be dimensioned from centerline of the nearest track. Crane locations shall also be dimensioned from a stationary point at the work site for field confirmation.

2. Computations showing the anticipated weight of all picks. Computations shall be made based upon the field-verified plans of the existing structure. Pick weights shall account for the weight of concrete rubble or other materials attached to the component being removed; this includes the weight of subsequent rigging devices/components. Rigging components shall be sized for the subsequent pick weight.

3. All lifting equipment, rigging devices, and other load bearing elements shall have a rated (safe lifting) capacity that is greater than or equal to 150% of the load it is carrying, as a factor of safety. Supporting calculations shall be furnished to verify the minimum capacity requirement is maintained for the duration of the hoisting operation.

4. Dynamic hoisting operations are prohibited when carrying a load with the Potential to Foul. Cranes or other lifting equipment shall remain stationary during lifting. (i.e., no moving picks).

5. For lifting equipment, the manufacturer's capacity charts, including crane, counterweight, maximum boom angle, and boom nomenclature is to be submitted.

6. A schematic rigging diagram must be provided to clearly call out each rigging component from crane hook to the material being hoisted. Copies of catalog or information sheets shall be provided to verify rigging weights and capacities.

7. For built-up rigging devices, the contractor shall submit the following:

i. Details of the device, calling out material types, sizes, connections and other properties.

ii. Load test certification documents and/or design computations bearing the seal and signature of a Professional Engineer. Load test shall be performed in the configuration of its intended use as part of the subject demolition procedure.

iii. Copies of the latest inspection reports of the rigging device. The device shall be inspected within one (1) calendar year of the proposed date for use.

8. A detail shall be provided showing the crane outrigger setup, including dimensions from adjacent slopes or facilities. The detail shall indicate requirements for bearing surface preparation, including material requirements and compaction efforts. As a minimum, outriggers and/or tracks shall bear on mats, positioned on level material with adequate bearing capacity.

9. A complete written narrative that describes the sequence of events, indicating the order of lifts and any repositioning or re-hitching of the crane(s).

IV. DEMOLITION PROCEDURE

A. The Agency or its Contractor shall submit a detailed procedure for a controlled demolition of any structure on, over, or adjacent to the ROW. The controlled demolition procedure must be approved by the Engineer prior to beginning work on the project.

B. Existing Condition of structure being demolished:

1. The Contractor shall submit as-built plans for the structure(s) being demolished

2. If as-built plans are unavailable, the Contractor shall perform an investigation of the structure, including any foundations, substructures, etc. The field measurements are to be made under the supervision of the Professional Engineer submitting the demolition procedure. Findings shall be submitted as part of the demolition means and methods submittal for review by the Engineer.

3. Any proposed method for temporary stabilization of the structure during the demolition shall be based on the existing plans or investigative findings, and submitted as part of the demolition means and methods for review by the Engineer.

C. Demolition work plans shall include a schematic plan depicting the proposed locations of the following, at various stages of the demolition:

1. All cranes and equipment, calling out the operating radii.

2. All proposed access and staging locations with all dimensions referenced from the center line of the nearest track

3. Proposed locations for stockpiling material or locations for truck loading

4. The location, with relevant dimensions, of all tracks, other railroad facilities; wires, poles, adjacent structures, or buried utilities that could be affected, showing that the proposed lifts are clear of these obstructions.

5. Note that no crane or equipment may be set on the CSX rails or track structure and no material may be dropped on CSX property.

D. Demolition submittal shall also include the following information:

1. All hoisting details, as dictated by Section III of this document.
2. A time schedule for each of the various stages must be shown as well as a schedule for the entire lifting procedure. The proposed time frames for all critical subtasks (i.e., torch/saw cutting various portions of the superstructure or substructure, dismantling splices, installing temporary bracing, etc.) shall be furnished so that the potential impact(s) to CSX operations may be assessed and eliminated or minimized.
3. The names and experience of the key Contractor personnel involved in the operation shall be included in the Contractor's means and methods submission.
4. Design and supporting calculations shall be prepared, signed, and sealed by the Professional Engineer for items including the temporary support of components or intermediate stages shall be submitted for review. A guardrail will be required to be installed in a track in the proximity of temporary bents or shoring towers, when located within twelve feet (12'-0") from the centerline of the track. The guardrail will be installed by CSX forces, at the expense of the Agency or its contractor.

E. Girders or girder systems shall be stable at all times during demolition. Temporary bracing shall be provided at the piers, abutments, or other locations to resist overturning and/or buckling of the member(s). The agency shall submit a design and details of the proposed temporary bracing system, for review by the Engineer. Lateral wind forces for the temporary conditions shall be considered in accordance with AREMA, Chapter 8, Section 28.6.2. The minimum lateral wind pressure shall be fifteen pounds per square foot (15 psf).

F. Existing, obsolete, bridge piers shall be removed to a minimum of three feet (3'-0") below the finished grade, final ditch line invert, or as directed by the Engineer.

G. A minimum quantity of twenty five (25) tons of CSX approved granite track ballast may be required to be furnished and stockpiled on site by the Contractor, or as directed by the Engineer.

H. The use of acetylene gas is prohibited for use on or over CSX property. Torch cutting shall be performed utilizing other materials such as propane.

I. CSX's tracks, signals, structures, and other facilities shall be protected from damage during demolition of existing structure or replacement of deck slab.

J. Demolition Debris Shield

1. On-track or ground-level debris shields (such as crane mats) are prohibited for use by CSX.
2. Demolition Debris Shield shall be installed prior to the demolition of the bridge deck or other relevant portions of the structure. The demolition debris shield shall be erected from the underside of the bridge over the track area to catch all falling debris. The debris shield shall not be the primary means of debris containment.
 - i. The demolition debris shield design and supporting calculations, all signed/sealed by a Professional Engineer, shall be submitted for review and acceptance.
 - ii. The demolition debris shield shall have a minimum design load of 50 pounds per square foot (50 psf) plus the weight of the equipment, debris, personnel, and all other loads.

iii. The Contractor shall verify the maximum particle size and quantity of the demolition debris generated during the procedure does not exceed the shield design loads. Shield design shall account for loads induced by particle impact; however the demolition procedure shall be such that impact forces are minimized. The debris shield shall not be the primary means of debris containment.

iv. The Contractor shall include installation/removal means and methods for the demolition debris shield as part of the proposed Controlled Demolition procedure submission.

v. The demolition debris shield shall provide twenty three feet (23'-0") minimum vertical clearance, or maintain the existing vertical clearance if the existing clearance is less than twenty three feet (23'-0").

vi. Horizontal clearance to the centerline of the track should not be reduced unless approved by the Engineer.

vii. The Contractor shall clean the demolition debris shield daily or more frequently as dictated either by the approved design parameters or as directed by the Engineer.

K. Vertical Demolition Debris Shield

1. This type of shield may be required for substructure removals in close proximity to CSX track and other facilities, as determined by the Engineer.

2. The Agency or its Contractor shall submit detailed plans with detailed calculations, prepared, signed, and sealed by a Professional Engineer, of the protection shield.

V. ERECTION PROCEDURE

A. The Agency or its Contractor shall submit a detailed procedure for erection of a structure with Potential to Foul. The erection procedure must be approved by the Engineer prior to beginning work on the project.

B. Erection work plans shall include a schematic plan depicting the following, at all stages of the construction:

1. All proposed locations of all cranes and equipment, calling out the operating radii.
2. All proposed access and staging locations with all dimensions referenced from the center line of the nearest track.
3. All proposed locations for stockpiling material or locations for truck loading.
4. The location, with relevant dimensions, of all tracks, other railroad facilities; wires, poles, adjacent structures, or buried utilities that could be affected, showing that the proposed lifts are clear of these obstructions.

C. No crane or equipment may be set on the CSX rails or track structure and no material may be dropped on CSX property.

D. For erection of a structure over the tracks, the following information shall be submitted for review and acceptance by the Engineer, at least thirty (30) days prior to erection:

1. As-built beam seat elevations – field surveyed upon completion of pier/abutment construction.
2. Current Top of Rail (TOR) elevations – field measured at the time of as-built elevation collection.
3. Computations verifying the anticipated minimum vertical clearance in the final condition which accounts for all deflection and camber, based upon the current TOR and as-built beam seat elevations. The anticipated minimum

vertical clearance shall be greater than or equal to that which is indicated by the approved plans. Vertical clearance (see definitions) is measured from TOR to the lowest point on the overhead structure at any point within six feet (6'-0") from centerline of the track. Calculations shall be signed and sealed by a Professional Engineer.

E. Girders or girder systems shall be stable at all times during erection. No crane may unhook prior to stabilizing the beam or girder.

1. Lateral wind forces for the temporary conditions shall be considered in accordance with AREMA, Chapter 8, Section 28.6.2. The minimum lateral wind pressure shall be fifteen pounds per square foot (15 psf).
2. Temporary bracing shall be provided at the piers, abutments, or other locations to resist overturning and/or buckling of the member(s). The agency shall submit a design and details of the proposed temporary bracing system, for review by the Engineer.
3. Temporary bracing shall not be removed until sufficient lateral bracing or diaphragm members have been installed to establish a stable condition. Supporting calculations, furnished by the Professional Engineer, shall confirm the stable condition.

F. Erection procedure submissions shall also include the following information:

1. All hoisting details, as dictated by Section III of this document.
2. A time schedule for each of the various stages must be shown as well as a schedule for the entire lifting procedure. The proposed time frames for all critical subtasks (i.e., performing aerial splices, installing temporary bracing, installation of diaphragm members, etc.) shall be furnished so that the potential impact(s) to CSX operations may be assessed and eliminated or minimized.
3. The names and experience of the key Contractor personnel involved in the operation shall be included in the Contractor's means and methods submission.
4. A guardrail will be required to be installed in a track in the proximity of temporary bents or shoring towers, when located within twelve feet (12'-0") from the centerline of the track. The guardrail will be installed by CSX forces, at the expense of the Agency or its Contractor.
5. Design and supporting calculations prepared by the Professional Engineer for items including the temporary support of components or intermediate stages shall be submitted for review.

VI. TEMPORARY EXCAVATION AND SHORING

A. The Agency or its Contractor shall submit a detailed design and procedure for the installation of a sheeting/shoring system adjacent to the tracks. Shoring protection shall be provided when excavating with Potential to Foul, or as otherwise determined by CSX. Shoring shall be provided in accordance with the AREMA, except as noted below.

B. Shoring may not be required if all of the following conditions are satisfied:

1. The excavation does not encroach within the Theoretical Live Load Influence Zone. Please refer to Figure 1.
2. The track structure is situated on level ground, or in a cut section, and on stable soil.
3. The excavation does not adversely impact the stability of a CSX facility (i.e., signal bungalow, drainage facility, undergrade bridge, building, etc), or the stability of any structure on, over, or adjacent to CSX property with potential to foul.
4. Shoring is not required by any governing federal, state, local or other construction code.

C. Shoring is required when excavating the toe of an embankment. Excavation of any embankment which supports an active CSX track structure without shoring will not be permitted.

D. Trench boxes are not an acceptable means of shoring. Trench boxes are prohibited for use on CSX property or within the Theoretical Railroad Live Load Influence Zone.

E. Shoring shall be a cofferdam-type, which completely encloses the excavation. However, where justified by site or work conditions, partial cofferdams with open sides away from the track may be permissible, as determined by the Engineer.

F. Cofferdams shall be constructed using interlocking steel sheet piles, or when approved by the Engineer, steel soldier piles with timber lagging. Wales and struts shall be included when dictated by the design.

G. The use of tiebacks can be permissible for temporary shoring systems, when conditions warrant. Tiebacks shall have a minimum clear cover of 6'-0", measured from the bottom of the rail. Upon completion of the work, tiebacks shall be grouted, cut off, and remain in place.

H. All shoring systems on, or adjacent to CSX right-of-way, shall be equipped with railings or other fall protection, compliant with the governing federal, state or local requirements. Area around pits shall be graded to eliminate all potential tripping hazards.

I. Interlocking steel sheet piles shall be used for shoring systems qualifying one or more of the following conditions:

1. Within 18'-0" of the nearest track centerline
2. Within the live load influence zone
3. Within slopes supporting the track structure
4. As otherwise deemed necessary by the Engineer.

J. Sheet piles qualifying for one or more of the requirements listed in Section VI.I (above) of this document shall not be removed. Sheet piles shall be left in place and cut off a minimum of 3'-0" below the finished grade, the ditch line invert, or as otherwise directed by the Engineer. The ground shall be backfilled and compacted immediately after sheet pile is cut off.

K. The following design considerations shall be considered when preparing the shoring design package:

1. Shoring shall be designed to resist a vertical live load surcharge of 1,880 lbs. per square foot, in addition to active earth pressure. The surcharge shall be assumed to act on a continuous strip, eight feet six inches (8'-6") wide. Lateral pressures due to surcharge shall be computed using the strip load formula shown in AREMA Manual for Railway Engineering, Chapter 8, Part 20.
2. Allowable stresses in materials shall be in accordance with AREMA Chapter 7, 8, and 15.3.
3. A minimum horizontal clearance of ten feet (10'-0") from centerline of the track to face of nearest point of shoring shall be maintained, provided a twelve feet (12'-0") roadbed is maintained with a temporary walkway and handrail system.

4. For temporary shoring systems with Potential to Foul, piles shall be plumb under full dead load. Maximum deflection at the top of wall, under full live load, shall be as follows:

- i. One-half (1/2) inch for walls within twelve feet (12'-0") of track centerline (Measured from centerline of the nearest track to the nearest point of the supporting structure).
- ii. One (1) inch for walls located greater than twelve feet (12'-0") from track centerline

L. Shoring work plans shall be submitted in accordance with Section II of this document, as well as the following additional requirements:

1. The work plan shall include detailed drawings of the shoring systems calling out the sizes of all structural members, details of all connections. Both plan and elevation drawings shall be provided, calling out dimensions from the face of shoring relative to the nearest track centerline. The elevation drawing shall also show the height of shoring, and track elevation in relation to bottom of excavation.
2. Full design calculations for the shoring system shall be furnished.
3. A procedure for cutting off the sheet pile, backfilling and restoring the embankment.

VII. TRACK MONITORING

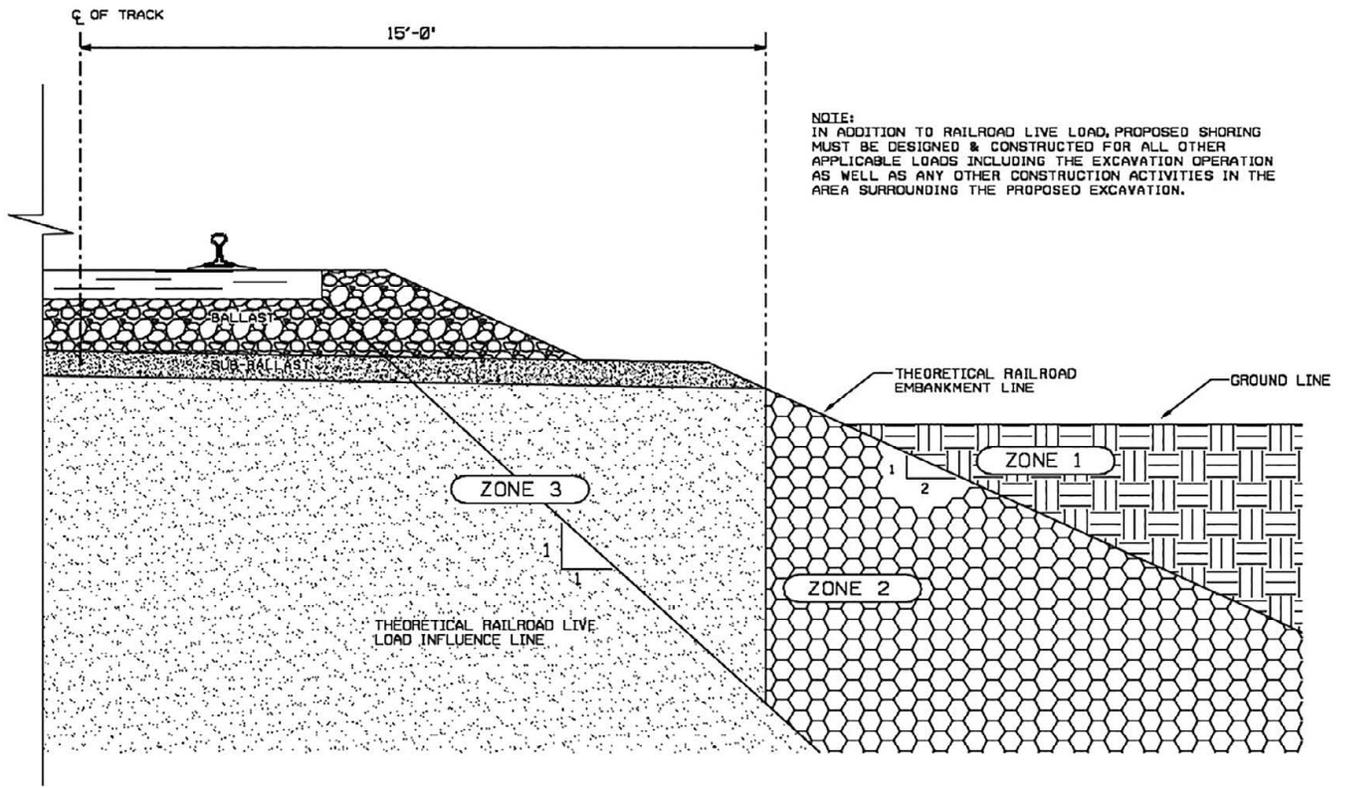
A. When work being performed has the potential to disrupt the track structure, a work plan must be submitted detailing a track monitoring program which will serve to monitor and detect both horizontal and vertical movement of the CSX track and roadbed.

B. The program shall specify the survey locations, the distance between the location points, and frequency of monitoring before, during, and after construction. CSX reserves to the right to modify the survey locations and monitoring frequency as necessary during the project.

C. The survey data shall be collected in accordance with the approved frequency and immediately furnished to the Engineer for analysis.

D. If any movement has occurred as determined by the Engineer, CSX will be immediately notified. CSX, at its sole discretion, shall have the right to immediately require all contractor operations to be ceased, have the excavated area immediately backfilled and/or determine what corrective action is required. Any corrective action required by CSX or performed by CSX including the monitoring of corrective action of the contractor will be at project expense.

FIGURE 1: Theoretical Live Load Influence Zone



NORMAL REQUIREMENTS FOR SHORING ADJACENT TO TRACK



ZONE 1 - EXCAVATIONS ABOVE AND OUTSIDE OF THE THEORETICAL RAILROAD EMBANKMENT LINE - DO NOT NORMALLY REQUIRE SHORING TO PROTECT RAILROAD ROADBED, SHORING MAY BE REQUIRED FOR OTHER REASONS.



ZONE 2 - EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 2 REQUIRE SHORING, BUT THE SHORING MAY NORMALLY BE PULLED AFTER THE EXCAVATION HAS BEEN BACKFILLED.



ZONE 3 - EXCAVATIONS WHOSE BOTTOMS EXTEND INTO ZONE 3 WILL NORMALLY REQUIRE THE SHORING TO BE LEFT IN PLACE AND CUT-OFF 3' BELOW BASE OF RAIL. SHORING MUST BE DESIGNED FOR COOPER E80 LIVE LOAD

**APPENDIX C -
CSX SOIL AND WATER
MANAGEMENT POLICY**

APPENDIX

CSX TRANSPORTATION

SOIL AND WATER MANAGEMENT POLICY

Any CSX environmental costs associated with a public project shall be borne by the Agency.

Public projects that generate soils from CSX property must adhere to CSX's soil management policies. CSX requires soils generated from its property to either be properly disposed in a CSX approved disposal facility or reused on CSX property. The management of soils generated from CSX property should be planned for and properly permitted (if applicable) prior to initiating any work on CSX property.

- Soil Reuse: CSX Environmental Department must review and approve reuse of soil on CSX property.
- Soil Disposal: If the soil cannot be reused on CSX property, it must be properly disposed at a CSX approved disposal facility. CSX prohibits any contractor from taking soils for off property reuse. CSX Environmental Department will handle waste characterization and profiling into an approved disposal facility. CSX prohibits any environmental sampling on its property unless granted through a written Environmental Right of Entry or approved in writing by the CSX Environmental Department. For access or right-of-entry issues for outside parties (Right-of-Entry) on CSX property please see: <https://www.csx.com/index.cfm/customers/value-added-services/property-real-estate/>. All analytical analyses must be completed at a CSX approved laboratory.

If Agency has arrangements with a disposal facility not approved by CSX, Agency can request CSX to evaluate the disposal facility. Request to evaluate alternate disposal facilities should take place prior to work being initiated on CSX property. Contact the CSX Manager Environmental Programs at (904) 366-4174 for assistance.

- If dewatering is planned for a public project, CSX Environmental Department must review and approve the dewatering plan prior to work being initiated on CSX property. CSX prohibits the discharge of water onto its property without prior approval. CSX prohibits environmental sampling of groundwater or surface water unless granted through a written Environmental Right of Entry or approved in writing by the CSX Environmental Department. Contact the Manager Environmental Programs at (904) 359-4833 for assistance.

All waste must be removed from the project site in a timely manner. It is the policy of CSX that all materials discarded by or on behalf of CSX will be managed in accordance with local, state and federal regulations as well as CSX's best management practices and sustainability goals. To ensure that these goals are achieved, CSX has mechanisms in place to monitor waste management activities, capture the information necessary to ensure 100% compliance with local, state and federal requirements 100% of the time, and track progress in the CSX sustainability program. These mechanisms also allow CSX to complete reporting requirements to federal and state regulatory agencies and document CSX's progress toward its sustainability goals.

Prior to disposal, recycling, or reuse, a CSX authorization number for transportation and disposal of all waste types (i.e. – hazardous, non-hazardous, special, etc.) must be obtained from the CSX Manager Environmental Programs and included on the disposal manifest or Bill of Lading (BOL). Promptly forward completed hazardous waste, non-hazardous waste, special waste manifests, BOLs, analytical, and profiles to the CSX Project Manager with copies to CSX's Manager Environmental Programs to wastedisposal@csx.com.

Containment system, clean up and disposal of all paint and other material removed from a bridge: The clean-up and disposal of material from the surface preparation for painting and the actual painting must comply with all appropriate regulations and CSX's policies and procedures. The materials removed during the surface preparation must not impact the surrounding area including ground, water, or air impacts. Materials must not be stored on CSX property.

A list of the CSX approved laboratories and disposal/recycling facilities can be obtained from the Manager Environmental Programs at wastedisposal@csx.com.

**APPENDIX D -
MTA WORK PERMIT
LICENSE APPLICATION**

Application Package – MTA Work Permit / License

This is Maine Turnpike Authority's Application for a Work Permit is required for work on MTA property of a temporary nature where no permanent facility will be installed.

Please review the attached application and the requirements of the sample documents. Any questions on these requirements may be directed to Ben Bolduc of the MTA's Right of Way Department.

Submit application and all related materials to:

Ben Bolduc
Maine Turnpike Authority
Right of Way Department
2360 Congress Street
Portland, ME 04102
Tel: (207)871-7771 x355
Fax: (207)879-5567
BBolduc@maineturnpike.com

MAINE TURNPIKE AUTHORITY WORK PERMIT

This Permit is granted by the Maine Turnpike Authority to _____ (“Permittee”) on the following terms and conditions.

In consideration for the right to enter the MTA’s property at the Wells Transportation Center in Wells, Maine (“the Premises”) and in consideration of the Permittee’s right to receive compensation under a contract with the Northern New England Passenger Rail Association to construct a passenger rail bridge and associated appurtenances on the Premises (“the Work”), which contract would not be possible without the grant of this Permit, Permittee agrees to the following:

1. Approval of Plans: Prior to any entry onto MTA property, Permittee shall supply the MTA with plans and specifications of the proposed Work, including any elements of the Work, such as erosion control measures, required to comply with permit requirements or regulations. Permittee shall make any changes to said documents requested by the MTA and shall not proceed with any Work until said documents have been reviewed and approved in writing by the MTA, or the MTA has declined in writing to review said plans.

2. Dig Safe: If earthwork is a component of the Work, notice to MTA must be given 10 days in advance of submitting a Dig Safe ticket. Proof of utility location from DigSafe must be provided to the MTA and approved before any work will be allowed under this permit.

3. Work on Property: Permittee must provide the MTA with a work plan, including schedule, traffic control plan, and any other documentation requested by the MTA. This documentation must be provided at least two weeks in advance of any Work covered by the plan. No Work may commence before the MTA has approved the documentation, or declined in writing to review said plans, and the documentation shall be adjusted, revised or supplemented as requested by the MTA in its discretion. The MTA may decide to have an MTA Inspector present during some or all of the Work and Permittee shall follow all instructions of the MTA Inspector regarding the time, manner and duration of the Work being conducted, and the MTA Inspector may require that Work be suspended due to safety or MTA operational considerations or if the Work, in the Inspector’s sole judgment, is not in compliance with the approved plans and specifications or with any applicable legal requirements.

4. Contractor Insurance: Permittee shall maintain general liability and automobile insurance with such limits as the MTA may approve, which shall not be less than \$ 5,000,000 per occurrence, and which shall name the MTA as an Additional Insured in all matters relating to the Work or Permittee’s presence on the Premises. These insurance policies must each contain the requirement that the MTA be given concurrent written notice of any cancelation, change in the limits of coverage or any alteration of the MTA’s additional insured status.

The insurance policies required by this permit should also contain the following provision: “Without limiting in any way Insurer’s obligation to defend the Additional Insured against any Claim or insure any promise of indemnification, this policy shall not be deemed a waiver of immunity or limitation on damages to which either the Insured or the Additional Insured it may be entitled to under the Maine Tort Claims Act or any source of statutory or common law.”

5. Indemnification: Regardless of the MTA's negligence or lack thereof, Permittee shall indemnify and hold the MTA harmless from and against any and all claims against the MTA from third parties, including employees of Permittee, and including fines or the expense of corrective actions resulting from violations of law or permit requirements, that arise from or are related to Permittee's Work or Permittee's presence on the Premises. This indemnification shall include indemnification for all costs related to said claims, including attorney's fees and defense costs. Nothing contained herein is intended to waive or modify the defenses and immunities available to the MTA with respect to third parties under the Maine Tort Claims Act or any other source of statutory or common law.

6. Release: Permittee releases the MTA from any and all claims it may have or which may arise against the MTA related to Permittee's Work on MTA property or MTA's actions pursuant to this Permit, including but not limited to claims against the MTA for physical damage, loss profit or expense allegedly arising from MTA instructions or suspension or modification or Work, and any other expense or damages whatsoever. Permittee agrees that MTA's rights under this Permit, including but not limited to the right to supervise Work, review plans, and require modifications, are optional, that the MTA has no responsibility for the Work, and that the MTA's failure to exercise any of its rights on one or more occasions does not release Permittee from any of its obligations under this Permit, including but not limited to the requirement that Permittee indemnify the MTA for any damages arising from the Work.

7. Permit Revocable at Will: This Permit is personal to Permittee and shall not be assigned or transferred to any other entity. This Permit is permissive and grants no rights in the Premises. The MTA may revoke this Permit upon written notice for any reason whatsoever that in the MTA's sole judgment warrants such a revocation, including but not limited to MTA operational needs or a violation of this permit. In the event of such a revocation, Permittee shall immediately cease all use of MTA property, shall remove all of its equipment or other property, and shall restore MTA property to the condition it was in prior to entry onto that property by Permittee. If Permittee fails to comply with this section within a reasonable time, the MTA may remove Permittee's property and restore the Premises at its own expense in which case Permittee will reimburse the MTA's expenses within a reasonable time of receiving an invoice itemizing those expenses.

8. Safety & MTA Operations: Permittee must abide by all applicable laws and regulations pertaining to workplace safety, and must also comply with the requirements of the most current MTA Supplemental Specification for construction contracts.

(<http://www.maineturnpike.com/Projects/Construction-Contracts.aspx>).

9. Contacts: Permittee shall comply with all other specific instructions of MTA personnel and take all other steps required to avoid or minimize disruption to MTA operations. Contacts: The following are the formal contact persons responsible for administration of this Work Permit. All material that Permittee is required to provide under this Permit must be provided to the MTA Contact listed below. When approval of the MTA is required under this permit, the MTA contact listed below is the only person authorized to grant said approval. Communications and direction addressed to Permittee's contact below will be binding upon Permittee.

MTA: _____

Permittee: _____

Address: 2360 Congress Street

Address: _____

Phone: _____

Phone: _____

Email: _____

Email: _____

Maine Turnpike Authority

Permittee

**Stephen R. Tartre, PE
Director of Engineering
Maine Turnpike Authority**

Name

Title

Company Name

SECTION 010009

INSURANCE REQUIREMENTS

PART 1 – GENERAL

1.1 INSURANCE REQUIREMENTS

- A. Section 110.3 Insurance of the State of Maine Department of Transportation Standard Specifications is removed in its entirety and replaced with the requirements of this Section. The Railroad insurance requirements specified in Section 010000 shall remain in effect.
- B. Insurance The Contractor shall provide signed, valid, and enforceable certificate(s) of insurance complying with this Section. All insurance must be procured from insurance companies licensed or approved to do business in the State of Maine by the State of Maine, Department of Business Regulation, Bureau of Insurance with an A.M. Best rating of A- VIII or better. The Contractor shall pay all premiums and take all other actions necessary to keep required insurances in effect for the duration of the Contract obligations, excluding warranty obligations.
- C. Workers' Compensation & Employers Liability For all operations performed by the Contractor and any Subcontractor, the Contractor and each Subcontractor shall carry Workers' Compensation Insurance or shall qualify as a self-insurer with the State of Maine Workers' Compensation Board in accordance with the requirements of the laws of the State of Maine. If maritime exposures exist, coverage shall include United States Long Shore and Harbor Workers coverage. Employers' liability limits shall not be less than \$1,000,000 each accident for bodily injury by accident or \$1,000,000 each employee for bodily injury by disease.
- D. Commercial General Liability With respect to all operations performed by the Contractor and any Subcontractors, the Contractor and any Subcontractors shall carry commercial general liability insurance in an amount not less than \$1,000,000.00 per occurrence and \$2,000,000.00 in the aggregate. The coverage must include products, completed operations, and Contractual liability coverages, and Insurance Services Office (ISO) form CG 25 03 or equivalent. The Contractual liability insurance shall cover the Contractor's obligations to indemnify NNEPRA as provided in this Contract, including Section 110.1 – Indemnification of the MaineDOT Standard Specifications. The contractual liability insurance shall also include coverage for any required indemnification of the Railroad using ISO form CG 24 17, specifically scheduling the Railroad and identifying the project location. The coverage shall also include protection against damage claims due to use of explosives, collapse, and underground coverage if the Work involves such exposures.

NNEPRA shall be named as an additional insured, using ISO additional insured endorsements CG 20 10 and CG 20 37 or their equivalent, including coverage for NNEPRA with respect to liability arising out of the ongoing and completed operations of Contractor. Completed operations coverage shall be maintained in effect for the benefit of NNEPRA for a period of 3 years following the completion of the work specified in this contract. Additional insured coverage as required in this subparagraph shall apply as primary insurance with respect to any other insurance or self-insurance programs afforded to NNEPRA.

When the work to be performed entails the use of barges, tugboats, work boats, supply boats, or other watercraft, Protection and Indemnity coverage for such work shall be provided at the limits called for under Commercial General Liability insurance.

- E. Automobile Liability The Contractor shall carry Automobile Liability Insurance covering the operation of all motor vehicles, including any that are rented, leased, borrowed, or otherwise used in connection with the Project. The minimum limit of liability under this Section shall be \$1,000,000.00 per occurrence.
- F. Professional Liability Contractors and Subcontractor(s) who engage in design Work, preliminary engineering Work, and environmental consulting Work for NNEPRA shall maintain a Professional Liability policy for errors and omissions that provides a minimum liability of \$1,000,000 per claim and annual aggregate. "Design Work" includes the design of temporary Structures and all other Work that requires design computations. This policy shall cover "Wrongful Acts," meaning negligent acts, errors, or omissions by the Contractor, or any entity for whom the Contractor is legally liable, arising out of the performance of, or failure to perform, professional services. NNEPRA reserves the right to adjust liability coverage on a project-by project basis as it deems appropriate.
- G. Owners and Contractors Protective Liability The Contractor shall carry an Owners and Contractors Protective (OCP) Policy covering all operations performed by the Contractor and any Subcontractor in an amount not less than \$1,000,000.00 per occurrence and \$2,000,000.00 in the aggregate, naming NNEPRA as the sole insured party under the policy.
- H. Builders Risk NNEPRA does not require the Contractor to carry Builders Risk Insurance. However, the Contractor is advised of its risks for damage to the Work as provided in Section 104.3.10 - Responsibility for Damage to the Work of the MaineDOT Standard Specifications. The Contractor is responsible for managing and insuring these risks as it deems appropriate.
- I. Pollution Liability The Contractor shall carry Pollution Liability insurance to cover the risk of sudden or accidental discharge of pollutants during the prosecution of the Work. The limits of liability for this coverage shall be in the amount of \$1,000,000.00 per occurrence and \$2,000,000.00 in the aggregate.
- J. Railroad Protective Liability The Railroad insurance requirements are specified in Section 010000.
- K. Umbrella/Excess Liability The Contractor shall carry umbrella liability insurance with limits of not less than \$10,000,000 Each Occurrence and \$10,000,000 General Aggregate. Umbrella/Excess liability coverage shall be at least as broad as the underlying General Liability, Automobile Liability and Employers Liability coverages.
- L. Waiver of Subrogation The Contractor waives all rights against NNEPRA and its agents, officers, directors and employees for recovery of damages to the extent these damages are covered by all insurance policies required pursuant to this Section.
- M. Administrative & General Provisions
1. Additional Insured Each insurance policy, with the exception of Workers' Compensation and Professional Liability insurance, shall list NNEPRA as an additional insured.
 2. Defense of Claims Each insurance policy shall include a provision requiring the carrier to investigate, defend, indemnify, and hold harmless all named insureds against any and all claims for death, bodily injury, or property damage, even if groundless. The Contractor's insurer shall name NNEPRA as a released party ("Releasee") on any release or settlement agreement for settled claims.
 3. Primary Insurance The insurance coverage provided by the Contractor shall be primary insurance with respect to NNEPRA, its officers, agents, and employees. Any insurance or self-insurance

maintained by NNEPRA for its officers, agents, and employees is in excess of the Agent's insurance and shall not contribute with it.

4. Reporting Any failure to comply with reporting provisions of the policies shall not affect coverage provided to NNEPRA, its officers, agents, and employees.
 5. Separate Application The insurance provided by the Contractor shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
- N. Nothing in this document constitutes a waiver of any defense, immunity or limitation of liability that may be available to NNEPRA or its officers, agents, or employees under the Maine Tort Claims Act (14 M.R.S.A. § 8101, et seq.), and shall not constitute a waiver of other privileges or immunities that may be available to NNEPRA.

END OF SECTION

SECTION 011000

DEFINITION OF CONTRACT LINE ITEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The intent of this section is to explain, in general, what is and what is not included in a contract line item, and the limits or cut-off points where one item ends and another begins.
- B. If no contract line item exists for a portion of the work, include the costs in a related item.
- C. Any estimated quantities of major elements of the work shown in the Contract Plans are approximate. It is the Contractor's responsibility to visit the project site prior to bid to identify existing conditions that will affect the work and determine the quantities of all materials required to complete the work at each location.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF CONTRACT LINE ITEMS

- A. Contract Line Item No. 1 – Base Proposal: Fixed price, lump sum, that includes all the work of this project. The Base Proposal includes all work shown in the Contract Plans and called for in the Specifications.

END OF SECTION

SECTION 012000

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section consists of Schedule of Values requirements.

1.2 SUBMITTALS

- A. Schedule of Values: After contract award and before the Pre-Construction conference submit a schedule of dollar values based on the Contract Price Schedule.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF VALUES

- A. Breakdown each lump-sum Contract Line Item into component work activities for which progress payments may be requested. The work activities broken out within the schedule of values shall be integrated into and made a logical part of the construction Schedule of Work. The total costs for the component work activities shall equal the contract price for that lump-sum item. The Resident may request data to verify accuracy of dollar values.
- B. The total cost of all items shall equal the contract price. The Schedule of Values will form the basis for progress payments.
- C. An acceptable Schedule of Values shall be agreed upon by the Contractor and Resident before the first progress payment is processed.

END OF SECTION

SECTION 020600

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section specifies requirements for temporary and permanent erosion and sedimentation control provisions as they relate to the construction process.
- B. This work includes:
 - 1. Providing and maintain all temporary erosion and sedimentation control measures shown on the Drawings and required by the Engineer during the life of the Contract to control soil erosion and water pollution.
 - 2. The installation and maintenance of additional silt fence, berms, ditches, sedimentation basins, construction exits, fiber mats, catch basin filters, straw, netting, gravel, trenches, mulches, grasses, slope drains, and other approved erosion control devices or methods, needed to protect any areas on or off site in accordance with the Storm Water Pollution Prevention Plan (SWPPP) to be developed by the Contractor which is required by the EPA or its' locally designated agency.
 - 3. Removal and legal disposal of temporary erosion control measures upon final stabilization.
- C. Erosion control barrier shall consist of hay bales and silt fence as detailed in the Drawings and/or as directed by the Engineer.
- D. Related work described elsewhere:
 - 1. Section 02200 – EARTHWORK
 - 2. Section 02485 – SEEDING AND SODDING

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The silt fence fabric shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.
- B. Each roll of fabric shall be labeled or tagged to provide product identification sufficient for field identification, as well as inventory and quality control purposes.
- C. Each roll of fabric shall be stored in a manner that will protect them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.
- D. Hay bales shall be stored in a manner that will protect them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof cover.

1.3 JOB CONDITIONS

- A. The Contractor shall be responsible for protection of slopes at 2:1 or steeper during the construction period and also during any maintenance period specified in Section 02485, Seeding and Sodding. Where clearing and grubbing, and regrading of such existing slopes is required, provide suitable means for erosion control. Re-grade slopes as necessary.

1.4 QUALITY CONTROL

- A. Erosion control mats shall be installed in accordance with the manufacturer's recommendations. Where manufacturer's recommendations conflict with details shown on the Contract Drawings, the more stringent, in the opinion of the Engineer, shall apply.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Calcium Chloride shall conform to the requirements of AASHTO-M144, Type I or Type II. Use mechanical spreader or other approved equipment.
- B. Hay bales shall be individually banded and staked into the ground:
 - 1. Hay bales shall consist of hay or straw for outdoor use be banded with string or nylon tape (minimum two bands per bale) and shall be staked into the ground as shown on the Drawings for Type A or Type B.
 - 2. Stakes for straw bales shall be 1-1/2 inch by 1-1/2 inch by 4 feet long, or approved equal
- C. Silt fence fabric shall be a woven fabric comprised of high tenacity polypropylene yarns. Silt fence shall be prefabricated with 1.25" (nominal) square hardwood posts. Silt fence shall meet the following criteria::

| | |
|----------------------------|------------------------|
| Grab Tensile Strength | 100 pounds |
| Grab Tensile Elongation | 15% |
| Trapezoidal Tear Strength | 50 pounds |
| Mullen Burst Strength | 300 pounds |
| Puncture Strength | 50 pounds |
| Apparent Opening Size | #30 US Sieve |
| Permitivity | 0.10 sec ⁻¹ |
| Flow rate | 8 gal/min/sf |
| UV Resistance at 500 Hours | 70% Strength Retained |

- 1. Posts for Silt Fence: Either wood, or synthetic posts may be used. Posts shall have a minimum length of 30" plus burial depth and be of sufficient strength to resist damage during installation and support applied loads.
- 2. Wire Support: 12-gauge wire supports at 6-inch maximum spacing each way shall be used when geotextile fabric is not strong enough to support applied loads. Provide hog supports.
- 3. Prefabricated fence systems may be used provided they meet all of the above material requirements.

D. Filter fabric at construction entrance shall be a woven fabric comprised of high tenacity polypropylene yarns. Filter fabric shall meet the following criteria:

| | |
|-----------------------------|------------------------|
| Wide Width Tensile Strength | 175 pounds/inch |
| Grab Tensile Strength | 315 pounds |
| Grab Tensile Elongation | 15% |
| Trapezoidal Tear Strength | 120 pounds |
| Mullen Burst Strength | 600 pounds |
| Puncture Strength | 120 pounds |
| Apparent Opening Size | #40 US Sieve |
| Permittivity | 0.05 sec ⁻¹ |
| Flow rate | 4 gal/min/sf |
| UV Resistance at 500 Hours | 70% Strength Retained |

E. Silt Sacks and Sediment Control Devices

1. Silt sacks shall be a woven polypropylene geotextile fabric with strength per ASTM D4884 manufactured to fit the opening of the catch basin. Silt sacks shall be Siltsack® as manufactured by ACF Environmental, Inc., or approved equal.
2. Silt sacks shall be manufactured with a high flow bypass weir for large inflow events. Field modification, including cutting or puncturing of the fabric, will not be allowed.
3. Install at locations indicated on the Drawings.

F. Compost-Filled Siltsocks

1. Siltsocks shall consist of 12-inch diameter multi-filament polypropylene mesh netting filled with compost filter media.
2. Siltsocks shall be Siltsoxx®, as manufactured by Filtrexx, or approved equal.

G. Straw Wattles shall consist of tubular polypropylene netting filled with agricultural straw fibers. Wattles shall be 12-inch diameter minimum unless otherwise indicated by Engineer.

PART 3 - EXECUTION

3.1 DUST CONTROL

- A. Leave existing pavement and/or ground covering in place until the last possible moment prior to final earth excavation for purposes of dust control.
- B. Calcium chloride and water shall be properly applied as required and/or where directed by the Engineer and distributed uniformly at the rate required or ordered. Method and equipment used to distribute the material shall be satisfactory to the Engineer.
- C. The Contractor is responsible for keeping dust down at all times, including non-working hours, weekends, and holidays. Sprinkle or treat, with dust suppressors, the soil at the site, and other areas disturbed by construction operations. No dry power brooming is permitted. Instead use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing is permitted only for cleaning nonparticulate debris, such as steel reinforcing bars. No sandblasting is permitted unless dust therefrom is confined. Only wet cutting of concrete blocks, concrete, and asphalt is permitted.

- D. Stop all earthwork when, as determined by the Engineer, dust control procedures have not proved effective in controlling dust. Resumption of work may only begin when site conditions have improved or constructions procedures are modified to the satisfaction of the Engineer.

3.2. TEMPORARY EROSION CONTROL

- A. Method of stripping vegetation shall be such as to minimize erosion. Fills shall be placed and compacted in such a manner that soil sliding and erosion is minimized. Grading shall be done in such a manner as not to divert water on to the property adjoining the Authority's right-of-way or construction site without expressed written permission of the land owner and the local Conservation Commission. If the Contractor fails to employ adequate and acceptable erosion control techniques during construction, the Engineer may order a suspension of the work until implementation of satisfactory techniques are agreed upon and demonstrated, and the Contractor shall have no claim for damages or time extension resulting from such delays.
- B. Staked hay bale siltation barriers shall be installed at the following locations:
 - 1. Toe of embankment construction.
 - 2. Toe of abutments/retaining walls and temporary earthwork stockpiles.
 - 3. Across construction ditches prior to entry into any drainage system or waterway.
 - 4. Other locations shown on the Contract Drawings, as dictated by the Order of Conditions or as designated by the Engineer.
 - 5. Toes of temporary earthwork stockpile.
 - 6. Straw bales shall be installed in line with each bale installed tight against the previous bale to form a continuous barrier. Secure bales in place with two (2) stakes per bale. The bales shall be set in a trench approximately 4 inches into the ground. Soil shall be placed on the upside slope of the bales. Deteriorated, destroyed, or rotted bales shall be replaced immediately. Sediment shall be removed and disposed of periodically from behind the straw bales. The accumulated sediment shall not be allowed to rise above the mid-height of the bale. All sediment, straw bales, and appurtenances shall be removed and disposed of at the completion of the Contract.
- C. Silt fence construction shall be adequate to handle the stress from sediment loading. Geotextile at the bottom of the fence shall be buried a minimum of 6 inches in a trench so that no flow can pass under the barrier. Trench shall be backfilled and the soil compacted over the geotextile. Fence height shall be as shown on the drawings, but in no case shall exceed 30 inches above ground surface. Geotextile shall be spliced together only at a support post with a minimum 6-inch overlap. Posts shall be installed six feet on center and angled slightly toward the embankment or anticipated source of runoff. Where an 18 inch depth is not possible, the post shall be adequately secured to prevent overturning of the fence due to sediment or wind loading.
 - 1. Silt fence shall be installed at locations as shown on the Drawings.
 - 2. Supporting posts shall be spaced 4 feet on center, and driven at least 1 foot into the ground. Posts shall be 1-1/2 inch square or heavier wood posts or standard steel posts.
 - 3. Fabric shall be anchored in a 4-inch deep trench dug on the upslope side of the posts. The trench shall be at least 4 inches wide. The fabric shall be laid in the trench, backfilled, and compacted.
 - 4. Fabric rolls shall be spliced at posts. The fabric shall be overlapped 6 inches, folded over, and then securely fastened to posts.
 - 5. Silt fences shall be inspected immediately after each storm event and at least daily during prolonged rainfall.

- D. Erosion control blankets shall be installed in accordance with the manufacturer's recommendations.
 - 1. Areas to receive blankets shall be smooth graded and compacted. Remove all rocks, dirt clods, vegetation, and other obstructions that may cause damage to the mats.
 - 2. Unroll blankets parallel to the direction of water flow and lay flat against the ground. Overlap roll ends a minimum of 1 foot with upslope mat on the top to prevent uplift of blanket end by water flow. Overlay adjacent edges of mat by six (6) inches. Extend blanket a minimum of 2 feet above the crest of steep slopes and anchor by excavating a 6 inch-deep trench, and secure end of blanket in trench using staples or pins furnished by manufacturer of blanket. After securing blanket end in place, backfill and compact trench.
- E. Sediment controls shall be in place prior to any soil disturbing activities including, but not limited to earthwork, clearing and grubbing, dewatering and excavation.
- F. Any disturbed soils shall be stabilized, either permanently or temporarily, within 2 weeks of disturbance or when directed by the Engineer.

3.3. MAINTENANCE AND CLEANUP

- A. The Contractor shall construct all permanent erosion and sedimentation control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sedimentation control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent erosion and sedimentation control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.
- B. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sedimentation control features can follow immediately thereafter, if conditions permit; otherwise, temporary erosion and sedimentation control measures will be required between successive construction stages.
- C. Contractor shall be responsible for controlling erosion within the project area and retaining sediment on-site away from sensitive environmental resources. Any fines, construction delays, remedial actions, or incarceration resulting from the Contractor's failure to comply with these provisions shall be the responsibility of the Contractor and not the Owner.
- D. Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including engineering costs, will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress payment.
- E. The Contractor shall remove and properly dispose of sediment from control facilities as required by the Engineer. The Contractor shall modify and improve erosion and sedimentation control facilities and replace deteriorated straw bales and other devices as required by the Engineer.
- F. Minimum temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the minimum provisions shown. Additionally, temporary measures shall be selected and constructed by the Contractor in consultation with the Engineer to accommodate changing field conditions that develop during construction.

- G. The temporary sedimentation basins shall be maintained from the start of construction until construction of the permanent detention basins and/or stormwater system is completed and perimeter areas are stabilized. A temporary outlet shall be constructed above the expected sediment levels. Construction of the basins shall be sequenced so that the temporary outlet is installed and basin embankment is constructed with the material available from the initial site excavations.
- H. All disturbed areas shall be re-vegetated by loaming and seeding unless otherwise noted on the approved plan, in accordance with Section 02485.
- I. The Contractor shall check the condition of erosion and sedimentation control devices daily and maintain them in good operating condition. Straw bales shall be replaced when deteriorated.
- J. The Contractor shall inspect the condition of diversion dikes and ditches, filter berms, interceptor dikes, sediment basins, and other erosion and sedimentation control devices after each rainstorm and during major storm events. Repairs shall be made as necessary.
- K. During construction, temporary outlets of the drainage systems shall direct the flow to temporary or permanent sedimentation basins.
- L. Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when required by the Engineer.

END OF SECTION

SECTION 021000

SITE PREPARATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items.
1. Clearing, grubbing, and disposing of vegetation, including bushes, brush, trees, stumps, fallen timber, logs, roots, rubbish, refuse, trash, and debris within the indicated limits.
 2. Protection from injury or defacement of vegetation and objects indicated or designated by the Engineer to be preserved.
 3. Removal, salvage, or other disposition of basement walls, slabs and footings; existing pavement, curbs and gutters, sidewalks, headwalls, walls, and steps; utility service facilities; guardrail and posts, highway and street signs and fences; and other miscellaneous structures and site improvements which interfere with construction, as indicated, or as required by the Engineer.
 4. Preparing site access roadways, storage areas, and security fencing.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 02060 – EROSION AND SEDIMENTATION CONTROL.
 2. Section 02221 – DEMOLITION.
 3. Section 02300 – EARTHWORK: removal if items completely buried below grade.
 4. Section 02650 – EXISTING SITE UTILITIES: maintenance, support, protection, relocation, reconstruction, adjusting-to-grade, restoration and abandonment of existing utilities.

1.2 SUBMITTALS

- A. Submit copies of requests for and certificates of severance of utility services to the Engineer prior to start of site preparation work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect indicated or designated trees with fencing to the approximate diameter of foliage to prevent damage to the trunk, foliage and root system by construction equipment or procedures.
- B. Protect other plants, monuments, existing improvements, adjacent property, and facilities from damage.

- C. Maintain protected vegetation in a healthy growing condition during construction.

3.2 CLEARING AND GRUBBING

- A. Clearing shall include cutting, removal, and off-site disposal of trees, bushes, shrubs, stumps, fallen timber, brush, refuse, trash, fencing and other incidental materials not required for reuse on the site. Do not start earthwork operations in areas where clearing and grubbing is not complete, except that stumps and large roots may be removed concurrently with excavation.
- B. The Contractor shall grub the area within the clearing limits to completely remove stumps and root systems, except for those to remain.
- C. Depressions, excavations and voids resulting from the removal of stumps or roots shall be filled with suitable material and compacted as specified under Section 02300 – EARTHWORK.

3.3 SELECTIVE CLEARING AND THINNING

- A. Selective clearing and thinning shall be completed as directed by the Engineer. Approximate limits of selective clearing and thinning are shown on the Drawings.
- B. The work shall include the removal of dead and diseased tree limbs and plants, and pruning and removal of live vegetation that interferes with the growth of other trees and plants. Areas of dense growth shall be thinned to provide room for healthy growth.
- C. Selective clearing and thinning shall be done in accordance with Maine Department of Environmental Protection regulations.

3.4 REMOVAL

- A. Remove entirely existing miscellaneous structures and site improvements that interfere with construction, as indicated, or as designated by the Engineer. Remove walls and masonry construction to a minimum depth of two feet below existing ground level in areas where such items do not interfere with construction.
- B. Abandoned Rail and Track Materials. Take possession of, remove, and dispose of off site, materials between boundaries located two feet outside of the rails and including the space between double tracks.
- C. Slabs may be broken and left in place where the Engineer determines it is not detrimental to the structural integrity of the fill or structure to be placed above.
- D. All removal must be done in accordance with applicable state and federal laws.

3.5 SALVAGE

- A. Salvage indicated material or material determined by the Engineer and Owner to be suitable for reuse, including: grates, frames, other metal castings and miscellaneous parts of inlets and manholes;

hydrants, fire alarm posts and boxes; metal light poles; sound pipe and valves; metal fencing; guard rail; and highway and street signs and posts.

- B. Protect metallic coatings on salvaged items. Remove adhering concrete from salvaged items.
- C. Repair, or replace with new material, salvaged material damaged or destroyed due to the Contractor's negligence.

3.6 BACKFILL

- A. Backfill and compact trenches and excavations resulting from work under this Section in accordance with Section 02300 - EARTHWORK.

3.7 INSPECTIONS

- A. Inspections: Contractor shall make a visual inspection of all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to off site areas, the Contractor shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly. Maintain stockpiles on site of siltation fence, hay bales and repair kits.

END OF SECTION

SECTION 022210

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items:
 - 1. Demolition, selective demolition and removal of structures and buildings.
 - 2. Demolition, selective demolition and removal of site improvements.
 - 3. Removing below-grade construction.
 - 4. Disconnecting, capping or sealing and removing site utilities.
 - 5. Salvaging items for reuse by the The Owner.

- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Division 15 Sections for demolishing or relocating site mechanical items.
 - 2. Division 16 Sections for demolishing or relocating site electrical items.

1.2 DEFINITIONS

- A. Demolish: Completely remove and legally dispose of off-site.
- B. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to the Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.
- C. Hazardous Material: as defined by the State of Maine.

1.3 MATERIALS OWNERSHIP

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

1.4 SUBMITTALS

- A. Proposed Protection Measures: Submit informational report in accordance with OSHA Part 1926 procedures, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings and Structures: Detail special measures proposed to protect adjacent buildings and structures to remain.
- B. Schedule of Building Demolition Activities: Indicate the following:
 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 2. Temporary interruption of utility services.
 3. Shutoff and capping or re-routing of utility services.
- C. Building Demolition Plans: Drawings indicating the following:
 1. Locations of temporary protection and means of egress for adjacent occupied buildings.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to The Owner prior to start of demolition.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition operations. Comply with Division 1. Submit before the Work begins.
- F. Hazardous material remediation plan. Included in the plan are landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- G. 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 state and federal regulations. Include name and address of technician and date refrigerant was recovered.
- H. Results of Professional Engineer's survey required by Article 3.1D.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing s notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Prepare a hazardous material remediation plan and submit to The Owner for approval.
- D. Predemolition Conference: Conduct conference at Project site to review methods and procedures related to building demolition including, but not limited to, the following:
 1. Review of hazardous material remediation plan.
 2. Inspect and discuss condition of construction to be demolished.
 3. Review structural load limitations of existing structures.
 4. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 5. Review and finalize protection requirements.
 6. Review procedures for noise control and dust control.
 7. Review procedures for protection of adjacent buildings.
 8. Review items to be salvaged and returned to The Owner.

1.6 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area may be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than 72 hours notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. The Owner assumes no responsibility for buildings and structures to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by The Owner as far as practical.
- D. Hazardous Materials: Hazardous materials may be present in buildings and structures to be demolished. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified or required by a duly licensed professional in the State of Maine and/or agency having jurisdiction.
- E. On-site storage or sale of removed items or materials is not permitted.

1.7 COORDINATION

- A. Arrange demolition schedule so as not to interfere with the Owner's operations and operations of adjacent occupied buildings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction provided by the Owner. The Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
- D. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

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

3.2 PREPARATION

- A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 - 3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- B. Existing Utilities: Refer to Division 15 and 16 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of demolition.
- D. Salvaged Items: Comply with the following:
 - 1. Clean salvaged items of dirt and demolition debris.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to The Owner.
 - 4. Transport items to storage area designated by The Owner.
 - 5. Protect items from damage during transport and storage.

3.3 PROTECTION

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

- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 1.
 - 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 - 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

- A. General: Where indicated on the Drawings, demolish existing buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain fire watch during and for at least four hours after flame cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 5. In general, demolish buildings top down.
- B. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.
- C. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from The Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- D. Explosives: Use of explosives is not permitted.

3.5 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be salvaged are indicated on Drawings.
- D. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, to at least depths indicated.
- E. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade unless indicated otherwise.

3.6 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

- A. Promptly repair damage to adjacent buildings, utilities, fences, or other structures caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and legally dispose of them in an state-approved landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.9 CLEANING

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

END OF SECTION

SECTION 022400

DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies dewatering to facilitate subsurface construction.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 02260 – EXCAVATION SUPPORT AND PROTECTION
 - 2. Section 02300 – EARTHWORK: excavating, backfilling, site grading and for site utilities

1.2 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control groundwater flow into excavations and permit construction to proceed on dry, stable sub-grades.
 - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to sub-grades and permanent structures is prevented.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
 - 4. Remove dewatering system if no longer needed.
 - 5. Provide for legal and suitable disposal of groundwater.
 - 6. Evaluate existing soil conditions and propose equipment and techniques to dewater both non-cohesive and cohesive soils.

1.3 SUBMITTALS

- A. Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.
 - 1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 - 2. Include a written report outlining control procedures to be adopted if dewatering problems arise.
 - 3. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For Installer and professional engineer.
- C. Photographs or videotape, sufficiently detailed, of existing conditions of adjacent structures and site work that might be misconstrued as damage caused by dewatering operations.

- D. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.
 - 1. Note locations and capping depth of wells and well points.
- E. Field Test Reports: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.
- F. Adjacent Foundations Report and Analysis: Record subsurface foundation systems of adjacent structures and evaluate impacts of groundwater removal; i.e. wood foundations and similar items.
- G. The Contractor shall dewater for the length of time necessary to complete the specified sub-surface improvements. Dewatering operations shall be stopped based on a mutual decision between the Contractor and the engineering consultant. Any requirements to remove portions of the dewatering system will be noted on the Drawings.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
- B. Professional Engineer: Engage a professional engineer licensed in the State of Maine to design and certify dewatering systems.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. The Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is available from the Owner.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent structures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared sub-grades, and from flooding site and surrounding area.
 - 2. Protect sub-grades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry sub-grades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, sub-grade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below sub-grade elevations of foundations, drains, sewers, and other excavations.
 - 1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids negative impacts on abutters, endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to the Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 OBSERVATION WELLS

- A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated and additional observation wells as may be required by authorities having jurisdiction.
- B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
- C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 1. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

END OF SECTION

SECTION 022600

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies temporary soils excavation support and protection systems.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 02240 – DEWATERING; for dewatering excavations.
 - 2. Section 02300 – EARTHWORK; excavating and backfilling for existing utilities.

1.2 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed construction loads.
 - 1. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements or facilities adjacent to excavation.
 - 4. Provide vibration monitoring to prevent impacts on adjacent structures and utilities.

1.3 SUBMITTALS

- A. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For Installer and professional engineer.
- C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems.

1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities currently serving structures owned by the Town of Wells, CSX, Amtrak or NNEPRA unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. The Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
 - 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
 - 1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

1.5 QUALITY ASSURANCE

- A. Have a registered engineer approve and inspect all excavation support areas on a periodic basis.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
- D. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. Timber Piling: ASTM D 25, species listed in AWWA C3, pressure-treated in accordance with AWWA C3.
- G. Seven Wire Strand: ASTM A 416, Grade 250 or 270, uncoated seven-wire, low-relaxation strand.
- H. Grout: Suitable for service, minimum 4,000 psi.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Engineer and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER BEAMS AND LAGGING

- A. Install steel soldier beams before starting excavation. Space soldier beams at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wales horizontally at spacings indicated on the approved shop drawings and secure to soldier beams.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill for, install, grout, and tension tiebacks into position. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.
3. Inspect tiebacks periodically to confirm anchors exhibit no movement.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by Engineer.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
 2. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

SECTION 022980

TEMPORARY PEDESTRIAN FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section specifies requirements for furnishing, installing, operating and maintaining temporary pedestrian facilities. Temporary pedestrian facilities shall be provided for all construction work zones.
- B. Except for the materials shown on the Drawings to be left in place, all materials provided by the Contract under this section shall be removed by the Contractor when no longer required

1.2 SUBMITTALS

- A. Submit plans of temporary pedestrian facilities for each phase of construction at least 30 days prior to implementation of that portion of the Work.
 - 1. Indicate construction zones, laydown areas, storage areas, and location of construction field offices. Indicate access locations for each zone.
 - 2. Indicate pedestrian routes and detours through and around each construction zone.
 - 3. Indicate all existing and temporary crosswalks.
 - 4. Indicate the extent and type of all proposed temporary pedestrian facilities.
 - 5. Indicate all directional signage and directional arrows.
 - 6. Indicate the proposed surface improvements in the areas of temporary pedestrian facilities.

1.3 QUALITY ASSURANCE

- A. Structural loads shall be calculated according to the Maine Building Code.
- B. Electrical components shall conform to the Maine Electrical Code.
- C. Temporary pedestrian facilities shall conform with:
 - 1. Americans With Disabilities Act, Accessibility Guidelines for Buildings and Facilities
 - 2. Maine Building Code
 - 3. Manual on Uniform Traffic Control Devices
 - 4. Occupational Health and Safety, Code 1926

1.4 PROJECT CONDITIONS

- A. Coordination will be required with the work requirements to install permanent paved walks, and curbs.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Precast concrete barriers meeting the specifications outlined by MaineDOT. Precast barriers are the only acceptable barrier where pedestrians are being protected from vehicular traffic.

2.2 METALS

- A. Chain-link fence meeting the Specification 02444.
- B. Hot galvanized pipe, ASTM A53 Type E, Grade B coated with zinc inside and outside. Brackets, plates, anchoring elements, and miscellaneous components shall be hot-dip galvanized.
- C. Welding shall conform with AWS D1.1 Structural Welding Code-Steel and AWS D1.3 Structural Welding Code-Sheet Metal.

2.3 WOOD

- A. Wood and Timber Members: Suitable for service, sized to limit deflection under full AASHTO H-20 and construction loading of 1/2 inch.
- B. Lumber shall be seasoned and have a maximum moisture of 19%.
- C. Dimensioned lumber shall be straight grained, sound S4S dressed lumber, grade Select Structural. Allowable species are Douglas Fir and Spruce-Pine-Fir.
- D. Plywood shall be 3/4 inch, exterior Medium Density Overlay.
- E. Plywood flooring shall be Sturdifloor Exposure-1, exterior adhesive type, 3/4 inch thick with non-skid epoxy resin and aggregate coat on exposed surfaces.

2.4 ELECTRICAL

- A. Fluorescent light fixtures shall be UL listed and suitable for wet and outdoor installations. Light housing shall be 20 gauge steel seamless with white corrosion resistant finish of baked enamel, epoxy or porcelain. Lamp shall be rapid start and energy saving type. Ballast shall be 120 V, Class P, thermally protected, high power factor.
- B. Electrical components shall be grounded. Metal frames shall be bonded to the electrical system grounding conductor as well as to a locally driven rod. Final installation of grounding system shall ensure that no point in the metal framing shall have a resistance measurement to local earth ground exceeding 2 ohms.
- C. Conduit shall be UL listed with corrosion resistant coating for all electrical system wiring, with all fittings meeting the Maine Electrical Code for outdoor installations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For each work area where temporary pedestrian facilities are used, perform on-site assembly expeditiously to minimize interference with the walking public and vehicular traffic. Complete and place in service all required temporary pedestrian facilities prior to the start of the construction work in the area.
- B. Prepare substrate surfaces to support barriers and fences with slopes not to exceed 5% in the direction of the traveling path and does not exceed 2% across the traveling path.
- C. Firmly secure temporary pedestrian facilities to substrates as required to resist all wind, snow, dead and live loads.

3.2 MAINTENANCE

- A. The Contractor is responsible to repair all temporary pedestrian facilities until it can be removed following construction
- B. The Contractor shall remove snow and ice, cleaning, and make all necessary repairs
- C. The Contractor shall inspect all temporary facilities daily and make all necessary repairs to maintain the structural integrity and allow safe passage by the walking public and vehicular traffic.
- D. Maintain the decking in an acceptable condition at all times.

END OF SECTION

SECTION 023000

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items.
1. Preparing subgrades for buildings, structures and landscaping
 2. Excavating, backfilling and compacting for buildings and structures.
 3. Drainage course for slabs-on-grade.
 4. Subbase course for bituminous and cement concrete pavements.
 5. Subsurface drainage backfill for walls and trenches.
 6. Excavating, backfilling and compacting for utility trenches.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 02100 – SITE PREPARATION; temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above and below-grade improvements and utilities.
 2. Section 02221 – DEMOLITION; removal of hazardous materials and underground storage tank removal.
 3. Section 02240 – DEWATERING; dewatering activities.
 4. Section 02260 – EXCAVATION SUPPORT AND PROTECTION; shoring and bracing.
 5. Section 03300 – CAST-IN-PLACE CONCRETE; granular course if placed over vapor retarder and beneath the slab-on-grade.
 6. Divisions 2, 15, and 16 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.2 DEFINITIONS

- A. Backfill: Soil and/or fill material and/or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside the pipe from the springline to the crown of the pipe or utility and 12-in over pipe or utility in a trench unless otherwise noted, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to approximate the gravel sub-base layer (12-in plus the thickness of the bituminous or cement concrete final surface) to fill a trench.
- B. Bedding Course: Granular material placed under structures or utilities to a depth of 12-in unless otherwise noted and to the springline of the pipe or utility or to the base of the structure.
- C. Borrow: Geotechnically and analytically satisfactory soil imported from off-site for use as fill or backfill.
- D. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices. Also called over excavation.
 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades. Fill (Urban Fill): In-situ material known as Fill, also known as urban fill or miscellaneous fill, is defined as a mixture of soil and other materials which have been located in the area through man-made processes primarily for the purpose of grading, backfilling or filling in low areas. Material commonly associated with urban fill includes, but are not limited to; glass, brick, ash, wood fragments and other similar granular materials. Urban fill shall not include boulders, ledge, consolidated rock, asphalt, concrete, railroad timbers, rail, cobblestones or any other abandoned building materials which would preclude the disposal of the urban fill as daily cover at a landfill. Material containing less than 10%, by volume, solid waste/debris, as determined by the Engineer, shall be classified as urban fill. Material that contains 10% or more solid waste/debris by volume, as determined by the Engineer, shall be classified as solid waste.
- G. Soil (Natural Soils): Soil, otherwise known as natural soil, is defined for the purposes of the Contract as unconsolidated sand, gravel, silt and clay, and the organic material which has become part of the unconsolidated soil matrix.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes, catch basins or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Course placed between the final backfill and the bituminous or cement concrete pavement.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

- A. The Owner may retain and pay for the services of an independent testing and inspection firm and/or a Geotechnical Consultant to perform on-site observation and testing during the various phases of the

construction operations. The scope of services will be determined by the Owner and the independent testing and inspection firm and/or the Geotechnical Consultant, and results will be provided to the Contractor. The Owner reserves the right to modify or waive the services of the independent testing and inspection firm and/or the Geotechnical Consultant. The services of an independent testing firm and/or Geotechnical Consultant may include, but not necessarily be limited to, the following:

1. Observation during excavation and dewatering of building areas and controlled fill areas.
 2. Laboratory testing and analysis of fill materials as specified herein and proposed by the Contractor for incorporation into the Work.
 3. Observation of construction and performance of water content, gradation and compaction tests at a frequency and locations that the independent testing and inspection firm and/or the Geotechnical Consultant may require. The results of these tests will be submitted to the Owner, Engineer, and Contractor on a timely basis so that action can be taken to remedy indicated deficiencies. During the course of construction, the independent testing and inspection firm and/or the Geotechnical Consultant will advise the Owner in writing, if at any time in their opinion, the Work hereunder is of unacceptable quality. Failure of independent testing and inspection firm and/or the Geotechnical Consultant to give notice, shall not excuse the Contractor from latent defects discovered in their work.
- B. The Contractor shall make provisions for allowing observations and testing of Contractor's work by the independent testing and inspection firm and/or the Geotechnical Consultant.
1. The presence of the independent testing and inspection firm and/or the Geotechnical Consultant does not include supervision or direction of the actual work of the Contractor, and their employees or agents. Neither the presence of the independent testing and inspection firm and/or the Geotechnical Consultant, nor any observations and testing performed by them, nor failure to give notice of defects shall excuse the Contractor from defects discovered in their work.
- C. Costs related to retesting due to unacceptable qualities of work and failures discovered by testing shall be paid for by the Contractor at no additional expense to Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.
- D. Whenever floodplain or wetland compensation areas are designated on the plans, grading elevations are to be considered critical to the volumetric calculations and shall be constructed by the Contractor in strict conformance with the indicated grades.

1.4 QUALITY CONTROL

- A. The Contractor shall assume full responsibility for control inspection and testing and give sufficient notice to the Engineer to permit the witnessing of the inspections or tests.
- B. The contractor shall engage a qualified, independent testing agency to perform quality control testing and inspections.

1.5 SUBMITTALS

- A. Submit, in an airtight container for the testing laboratory, a 50-pound sample of each type of off-site fill material that is to be used at the site. Submit samples a minimum of one week prior to use of proposed material at the site. Submit samples to the testing laboratory and/or the Geotechnical Consultant (copy of these transmittal forms shall be simultaneously sent to Engineer) or if no testing laboratory and/or Geotechnical Consultant is identified, then the Engineer shall be the recipient of the samples. Use of these proposed materials by the Contractor prior to testing and approval shall be at the Contractor's risk.
- B. The Engineer will determine the suitability of all materials.
- C. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the project will require approval of the Owner or Engineer.
- D. For use of geotextile fabrics or geogrids, submit manufacturer's product data including material properties for approval by the Engineer.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Client/Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify the Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without the Engineer's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- C. As construction proceeds, the Contractor shall be responsible for notifying the Owner and Engineer prior to the start of earthwork operations requiring observation and/or testing
- D. Subsurface Soil Data
 - 1. A geotechnical engineering report has been prepared by GZA Environmental. This report is specifically not part of the Contract Documents but is available to bidders for informational purposes.
 - 2. Review available logs of borings, test pit logs, jar soil samples, records of explorations and other pertinent data for the site. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.
 - 3. Subsurface soil data is provided for general information and is accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and to draw conclusions based on the character of materials to be encountered and the impact on their work based on their expert knowledge of the area and of earthwork techniques.

4. The Drawings in the geotechnical report showing existing ground elevations are only for whatever use the Contractor may make of them with no responsibility on the part of the engineers, surveyors, the Owner, the Engineer, and/or their representatives for the accuracy and/or the reliability of the information given.
5. If a potential conflict exists between the Geotechnical Report and these technical Specifications, the Contractor shall, immediately upon its discovery, request clarification from the Owner's Representative or the Engineer.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Soil, Fill and Borrow Materials:

1. Common Borrow (Section 703.18)

- a. Common borrow shall consist of earth, suitable for embankment construction. It shall be free from frozen material, perishable rubbish, peat, and other unsuitable material including material currently or previously contaminated by chemical, radiological, or biological agents unless the material is from a DOT project and authorized by DEP for use.

2. Granular Borrow (Section 703.19)

- a. Granular borrow shall consist of sand or gravel of hard durable particles free from vegetable matter, lumps or balls of clay, frozen material and other deleterious substances. The gradation of that portion passing a 3 inch sieve shall meet the gradation requirements of the following table:

| Sieve Size | Percent Passing by Weight | |
|------------|---------------------------|-------------------------|
| | Underwater Backfill | Embankment Construction |
| No. 40 | 0-70 | 0-70 |
| No. 200 | 0-7 | 0-20 |

- b. Granular borrow for underwater backfill shall contain no particles or fragments larger than 6 inches. Granular borrow for embankment construction shall contain no particles or fragments with a maximum dimension in excess of the compacted thickness of the layer being placed.
3. Gravel Borrow (Section 703.20): Gravel borrow shall consist of well graded granular material having no rocks with a maximum dimension over 6 inches. The gradation of that portion passing a 3 inch sieve shall meet the gradation requirements of the following table:

| Sieve Size | Percent Passing by Weight |
|------------|---------------------------|
| ¼ inch | 0-70 |

| | |
|---------|------|
| No. 200 | 0-10 |
|---------|------|

4. Underdrain Backfill Material (Section 703.22, Type C): Material for underdrain shall be free from organic matter, frozen material and shall conform to the following tables:

| Sieve Size | Percent Passing by Weight |
|------------|---------------------------|
| 1 inch | 95-100 |
| ½ inch | 75-100 |
| No. 4 | 50-100 |
| No. 20 | 15-80 |
| No. 50 | 0-15 |
| No. 200 | 0-5 |

5. Crushed Stone (Section 703.31): 2-Inch Crushed stone shall be obtained from rock of uniform quality and shall consist of clean, angular fragments of quarried rock, free from soft disintegrated pieces or other objectionable matter. Stone shall meet the following requirements:

| Sieve Size | Percent Passing by Weight |
|------------|---------------------------|
| 2 ½ inch | 100 |
| 2 inch | 95-100 |
| 1 inch | 0-30 |
| ¾ inch | 0-5 |

- B. Aggregates and Related Materials shall meet the requirements outlined in MaineDOT Section 700.

2.2 GEOTEXTILES AND FILTER FABRIC

- A. Filter Fabric used with riprap, stone for pipe ends, slope paving, or channel paving (grouted or ungrouted) shall be as Mirafi 600X or approved equivalent.
- B. Filter Fabric used for prevention of soil intrusion into drains or to assist in stabilizing soil subgrades shall be Mirafi 140N or approved equivalent.
- C. Filter fabric in drainage recharge systems, underdrain systems between crushed stone and granular soils, leaching areas, or where indicated on the plans shall be Mirafi 140N or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Section 02100 - SITE PREPARATION.
- C. Protect and maintain erosion and sedimentation controls, which are specified in Section 02100 - SITE PREPARATION, during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Comply with requirements of Section 02240 - DEWATERING.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives. Use of explosives is subject to consideration by the Client/Owner only on a case-by-case basis.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include bituminous and cement concrete sidewalks and roadways, bricks and cobbles, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of concrete forms other than at footings.
 - b. 12 inches outside of concrete forms at footings.
 - c. 6 inches outside of minimum required dimensions of concrete cast against grade
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 12 inches beneath bottom of concrete slabs on grade.
 - f. 12 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
 - 3. Contaminated Materials
 - a. The Contractor shall be familiar with the Maine Department of Environmental Protection (DEP) Hazardous Waste Regulations Chapters 850 through 858 when conducting earthwork operations.
 - b. In general, a hazardous waste (contaminated with oil or hazardous materials) is a waste or combination of wastes which, because of its quantity, concentration, physical, chemical or infectious characteristics, may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety, or welfare, or to the

- environment when improperly stored, treated, transported, or disposed of, or otherwise managed.
- c. The Contractor shall immediately halt soil movement activities and notify the Owner and Engineer if visual, olfactory, or other evidence suggests that soils may be contaminated with oil or hazardous materials. Contractor shall provide reasonable assistance to Owner and to Owner's Representative for access to potential contamination areas for proper assessment of hazardous conditions.
 - d. The Owner will contact an environmental professional (Licensed Geologist in the State of Maine) to test any earth materials suspected of containing hazardous waste. The results shall be evaluated by the environmental professional and compared with reporting thresholds found in the DEP regulations. The Owner will inform the Contractor of the laboratory test results as soon as possible and discuss the possible soil management, disposal, and recycling options available. Contaminated soils shall be managed and handled in compliance with the referenced state & federal regulations, guidelines, and policies. Time and expenses associated with contaminated soils shall be negotiated between the Contractor and the Owner prior to the start of the soil management, soil disposal, and recycling work. Owner reserves the right to negotiate and contract with other entities for remedial work and, in that event, this Contractor shall make reasonable accommodations for other entities to perform this work.
 - e. Although there is no evidence of oil or hazardous material, there is a possibility of the presence of such wastes on this site. Appropriate testing, as recommended by an environmental professional shall be accomplished to assess the potential presence of oil or hazardous material. Earth material shall not be removed from the site unless on-site reuse is not possible.
 - f. Proper documentation of legal disposal of hazardous materials handled by this Contractor shall be provided by the Contractor to the Owner, Engineer, and review authorities.
 - g. Unless specifically identified as contaminated material under referenced statutes and as defined above, as judged by the Engineer, excavated materials shall be considered unclassified as defined in Item A., above.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch if applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. If material remaining at bottom of trench is disturbed, recompaction shall be required.
 - 2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 - 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces. If material remaining at bottom of trench is disturbed, recompaction shall be required.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line unless otherwise noted.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 SUBGRADE INSPECTION

- A. Notification Point - Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with backfill with crushed stone wrapped with non-woven geotextile fabric.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with crushed stone wrapped with non-woven geotextile fabric.

- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi may be used when approved by Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe with crushed stone wrapped with non-woven geotextile fabric as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of water, mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Sand borrow bedding shall be placed by hand shovels, in layers not more than 4-inches thick in loose depth, and each layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe, free from voids. Crushed stone bedding material shall be placed in layers not more than 6-inches thick in loose measure, and compacted with at least 4 passes using a vibratory plate or roller compactor.

- C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03300 - CAST-IN-PLACE CONCRETE.
- D. Place and compact initial backfill of material free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation in uncompacted layers not to exceed 9 inches.
- G. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed, the Contractor, as required by the Engineer, shall make special leakage tests of the structures. After the satisfactory completion of leakage tests and the satisfactory completion of any other required work in connection with the structures, the backfilling around the structures shall proceed using Controlled Density Fill (CDF) material. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures.
- H. Install warning tape directly above utilities, no less than 12 inches above the crown of the pipe or utility and no more than 16 inches above the crown of the pipe or utility.

3.13 EMBANKMENT FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent minimum; and areas within 10 feet of structures, building slabs, steps, and pavements at 95 percent minimum.
 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent minimum.
 3. Under lawns, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent minimum.
 4. Under unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent minimum.
 5. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent minimum.
 6. For embankments, compact each layer at minimum 92 percent minimum.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 2. Walks: Plus or minus 1 inch.
 3. Pavements: Plus or minus 1/2 inch.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Section 02400 - DRAINAGE AND SEWER SYSTEMS.
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight according to ASTM D 1557.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.
 - 1. Compact each filter material layer to 90 percent of maximum dry unit weight according to ASTM D 1557.
 - 2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.18 SUBBASE COURSE

- A. Place subbase course on subgrades free of water, mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course under pavements and walks as follows:
 - 1. Shape subbase course to required crown elevations and cross-slope grades.
 - 2. Place subbase 6 inches or less in compacted thickness in a single layer.
 - 3. Place subbase that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 DRAINAGE COURSE

- A. Place drainage course on subgrades free of water, mud, frost, snow or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 90 percent of maximum dry unit weight according to ASTM D 1557.

3.20 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor shall engage a qualified independent testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
- D. An Independent Laboratory will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than 3 tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet or less of wall length, but no fewer than 2 tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet or less of trench length per lift, but no fewer than 2 tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained. Client/Owner will conduct confirmatory testing.

3.21 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the User Agency's property.

END OF SECTION

SECTION 023010

SUBSURFACE INVESTIGATION

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 SUBSURFACE INVESTIGATION

- A. Information Not Guaranteed: Information on the Drawings and in the Project Manual relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.
- B. Foundation Engineering Report: Refer to the Geotechnical Report in the Appendices.

1.3 CONFIRMATION OF GRADES AND UTILITIES

- A. Prior to commencement of site excavating operations, the Contractor shall compare existing site grading and proposed new site grading. Where existing utilities are indicated but their inverts or depths are not, exploratory excavating shall be performed to assure that sufficient earth coverage will be attained during the course of new site grading.
 - 1. Utilities existing on the site shall be carefully protected from damage and relocated or removed as required by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings and the Owner, Owner's Representative(s) and the utility owner notified in writing.
- B. If exploratory excavating confirms that the depth of existing utilities will be negatively impacted by proposed new grades (i.e., will be too shallow or become exposed), immediately notify the Owner, Owner's Representative(s). Do not proceed with work in such areas until instructions are issued by the Owner, Owner's Representative(s). Continue work in other areas.

1.4 CONFIRMATION OF INTEGRITY OF ADJACENT STRUCTURES

- A. Prior to commencement of site excavating operations, the Contractor shall compare foundation depths of existing structures and proposed depths of new utilities. Where existing structures are

indicated but their foundation depths are not, exploratory excavating shall be performed to assure that proposed new excavations adjacent to them, or in near proximity of them, will not undermine the structural integrity of the existing structures.

- B. If exploratory excavating confirms that the footing depths of existing structures may be negatively impacted or undermined by proposed new excavations, immediately notify the Resident and the Owner. Do not proceed with work in such areas until instructions are issued by the Resident. Continue work in other areas.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION [Not Used]

END OF SECTION

SECTION 024000

DRAINAGE AND SEWER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies construction of drainage facilities and sanitary sewer facilities.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 02300 – EARTHWORK
 - 2. Section 03300 – CAST-IN-PLACE CONCRETE

1.2 SUBMITTALS

- A. Shop Drawings. Include details of sewers and drains, including relationship to other systems; true position and details of interfaces, connections, inlets, cleanouts, manholes, castings, alignment, grade, changes of direction, offsets, bedding, protection, materials and other pertinent data.

1.3 PRESSURE AND LEAKAGE TESTING AND TOLERANCES

- A. Gravity Lines: Maximum allowable leakage for any section or sections, or for the total lengths of pipelines: 200 gallons per inch of diameter per mile per 24 hours.
- B. Polyvinyl Chloride PVC:
 - 1. Testing of Pipe: After completing installation and backfill of pipe, the Contractor shall, at his expense, conduct a line acceptance test using low pressure air. Equipment used shall meet the following minimum requirements: Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected; Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking; All air used shall pass through a single control panel. Three individual hoses shall be used for the following connections: From control panel to pneumatic plugs for inflation; From control panel to sealed line for introducing the low pressure air; From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
 - 2. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig (172.3689 Kpa). The sealed pipe shall be pressurized to 5 psig (34.47378 Kpa). The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
 - 3. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig (172.4 Kpa). Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig (27.579 Kpa) greater than the average back pressure of any groundwater that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.

4. After the stabilization period (3.5 psig (24.1317 Kpa) minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (24.1317 to 17.2369 Kpa) (greater than the average back pressure of any groundwater that may be over the pipe) is not less than the time shown for the given diameter in the following table.

| Pipe Diameter | Specification Time for Length Shown (min: sec) | | | |
|---------------|--|---------|---------|---------|
| | Inches | 100 ft. | 200 ft. | 300 ft. |
| 6 | 5:40 | 5:40 | 5:40 | 5:42 |
| 8 | 7:34 | 7:34 | 7:36 | 10:08 |
| 10 | 9:26 | 9:26 | 11:52 | 15:49 |
| 12 | 11:20 | 11:24 | 17:05 | 22:47 |
| 15 | 14:10 | 17:48 | 26:42 | 35:36 |
| 18 | 17:00 | 25:38 | 38:27 | 51:16 |
| 21 | 19:50 | 34:54 | 52:21 | 69:48 |
| 24 | 22:47 | 45:34 | 68:22 | 91:10 |

5. In areas where groundwater is known to exist, the Contractor shall install a 1/2 inch (1.27cm) diameter capped pipe nipple, approximately 10 inches long, through the manhole wall adjacent to one of the sewer lines entering the manhole. This shall be done at the time the line is installed. Immediately prior to the performance of the Line Acceptance Test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11 1/2 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same). In no case shall the starting pressure exceed 9.0 psig.
6. If the Contractor is unable to pass a pressure test because lines are "live", the Contractor shall perform closed circuit television inspections of the lines at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.
7. Test Failure: If the section of pipe fails to pass the leakage and pressure test, or if there is any visible leakage, the Contractor shall locate, uncover and repair or replace the defective pipe fitting or joint and retest all at his own expense. Pipe will be considered passing only when the leakage does not exceed the above standard. Passing the test does not absolve the Contractor from his responsibility if leaks develop later within the period of warranty.

C. RCP:

1. Leakage Tests: Leakage tests will be required by the Owner for all pipe and manhole installations. Tests shall meet all requirements of this paragraph. Leakage into or from the piping and structures, except storage tanks, will be determined respectively by infiltration tests or by exfiltration tests, as specified herein and as directed. The maximum allowable amount of infiltration into the piping or exfiltration from the piping as determined respectively by the infiltration tests or by the exfiltration tests, including manholes, shall be at a rate of not greater than 150 gallons (567.8l) per inch of pipe diameter per mile of pipe per 24 hours, and there shall be no gushing or spurting streams of water into or from the piping or manholes. The phrase, "per mile of pipe" shall refer to the total length of pipe measured through manholes. Where the groundwater level can be maintained at a height of not less than one foot (304.8 mm) above the top of the pipe for the full length of the section of pipe being tested for leakage, the leakage into the piping and manholes shall be determined as specified under "Infiltration Tests." Where the groundwater cannot be maintained at a level of not less than one foot (304.8 mm) above the top of the pipe for the full length of the section of pipe being tested, the leakage from the piping and manholes shall be determined as specified under "Exfiltration Tests". Perform all work, provide all necessary weirs or such other measuring devices as required, do all pumping and furnish all equipment necessary for the proper performance of leakage tests at no additional cost to the Owner. Leakage testing of piping shall be satisfactorily performed in sections as the work progresses, and as directed.
2. Infiltration Tests: The tests shall be conducted at such times as the groundwater level is at a height of not less than one foot (304.8 mm) above the top of the pipe for the full length of the section of the pipe being tested. The groundwater leakage into the pipe will be measured by the Owner at such point or points as he may direct. Construct such weirs or other means of measurement as required and pump as necessary for the tests to be properly made.
3. Exfiltration Tests: Where exfiltration tests are required, the section of pipe to be tested shall be subjected to an internal pressure. The lower end of the section of pipe to be tested shall be closed and the entire section of the pipe, including manholes, shall be filled with clean water so as to obtain a minimum head of 2 feet (0.6096 m) above the top of the pipes; the length of the section of pipeline being tested shall be such that with the head of water 2 feet (0.6096 m) above the top of pipe at the upper end of the section of the pipeline being tested will not exceed 8 feet (2.4384 m). The rate of leakage from each section of the pipe being tested will be determined by the Owner by measuring the amount of water required to maintain the minimum head of 2 feet (0.6096 m) above the top of the pipe for the full length of each section of the pipes being tested.
4. Should the infiltration or exfiltration test on any section of the pipelines, including manholes, show a rate of leakage into or from the pipeline exceeding the maximum allowable rate of infiltration or exfiltration specified herein, locate, repair, or replace defective joints and work in a manner satisfactory to the Owner and retest at no additional cost to the Owner until the rate of infiltration into or exfiltration from each section of the pipeline being tested does not exceed the rate specified herein for infiltration or exfiltration.
5. The completed pipe and joints shall be visually inspected by the Engineer. If the Contractor is unable to pass a pressure test because lines are "live", the Contractor shall perform closed circuit television inspections of the lines at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

D. Drainage and Sanitary Structures and Catch Basins, Leakage Tests:

1. The manholes shall be made as nearly watertight as practicable.
2. The Contractor shall perform leakage tests on each manhole installed using an approved low air pressure testing system. This type of test shall be used only immediately after assembly of the

manhole and only prior to backfilling. The manhole to pipe connection should only be a flexible connector. All lift holes shall be plugged with a non-shrinking mortar. For this test, each manhole shall be tested under 10-inch Hg vacuum. The test shall pass if the vacuum remains at 10-inch Hg or drops no lower than 9-inch Hg after 60 seconds for 4 or 5 foot manholes from 0 to 10 feet deep, 75 seconds for 4 or 5 foot manholes from 10 to 15 feet deep, or 90 seconds for 4 or 5 foot manholes from 15 to 25 feet deep. A volume equivalent shall be calculated for larger diameter manholes to determine the testing length based on these parameters.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Products used at interface with utility companies shall conform to the requirements of connected utility companies.

2.2 PIPE AND FITTINGS

- A. Reinforced Concrete Pipe

- 1. Circular Section: ASTM C 76; ends, class, and wall as indicated.
 - 2. Elliptical Section: ASTM C 507; ends and class as indicated.

- B. Joints and Gaskets for Circular Concrete Pipe: ASTM C 443.

- C. Polyvinyl Chloride Pipe:

- 1. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating or stiffness in psi (kpa).
 - 2. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.
 - 3. Pipe:
 - a. All PVC pipe shall be joined by compression joints unless otherwise shown or specified, and shall conform to the following requirements:
 - b. Non Perforated Polyvinyl chloride pipe (PVC) shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. All diameters shall be as specified on the Contract Drawings.
 - c. Perforated PVC pipe shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for perforated PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. The pipe shall have 3/8 inch perforations, 6 inch on center and 4 holes per row. The pipe shall be 6 inch diameter unless otherwise specified on the Contract Drawings.
 - d. Elastomeric seals for compression type joints for PVC pipe and fittings shall conform to the requirements of ASTM D 3212.

- e. Service pipes for storm services shall be minimum of 8-inches and shall match diameter of existing services for reconnections. Service pipes for sanitary services shall be minimum of 6-inches and shall match diameter of existing, services for reconnections.
- 4. Fittings:
 - a. All fittings shall conform to the requirements of ASTM D 3034 or ASTM F 679. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible with cast-iron or ductile iron pipe fittings.
 - b. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.
 - c. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- 5. Connections:
 - a. Sanitary services shall be connected to new, parallel or replacement sanitary sewer lines with full bodied tees or wye fittings.
 - b. Storm services shall be connected to new, parallel, or replacement storm sewer lines with full bodied tees or wye fittings for all pipes up to 18-inches in diameter. Connections to pipes larger than 18-inches in diameter or odd sizes shall be made with saddle tap connections, as approved by Engineer.
 - c. Connections of storm and sanitary service lines to existing storm and sanitary main lines shall be made with full bodied tees or wye fittings wherever possible for existing lines less than 18-inches in diameter and with tapping saddles as approved by Engineer for existing lines greater than 18-inches in diameter and in odd sizes.
- 6. Gaskets: Flexible elastomeric rings conforming with ASTM F 477.

D. Solid Wall High Density Polyethylene Pipe (HDPE):

- 1. The HDPE replacement pipe shall be manufactured from a high density, high molecular weight polyethylene resin, which conforms to ASTM D-1248 and meets the requirements for Type III, Class B, Grade P34, Category 5, and has a PPI rating of PE 3408, when compounded. The pipe produced from this resin shall have a minimum cell classification of 345434C or D under ASTM D 3350.
- 2. The wall thickness of the HDPE pipe shall be as determined by the Contractor for the minimum thickness required to meet the structural requirements listed under Design Criteria below, and shall meet the following:
- 3. Minimum Wall Thickness: 0-12 feet depth, minimum wall thickness SDR 26; over 12 feet depth, SDR 21 minimum wall thickness.
- 4. All pipe shall be made of virgin material. No re-work, except that obtained from the manufacturer's own production of the same formulation shall be used.
- 5. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults.
- 6. The interior surface of the HDPE pipe shall not be dark or non-reflective in nature that could inhibit proper television inspection.
- 7. The finished HDPE pipe shall be continuous over the entire length of an insertion run between the insertion pit and reception pit. The HDPE pipe shall be impervious and free of any leakage from the rehabilitated host pipe to surrounding ground, or from the surrounding ground to the inside of the pipe.
- 8. The manufacturer of the pipe shall supply the Owner with certificates of compliance indicating conformance for all material and testing requirements furnished under these Specifications.
- 9. Each standard pipe unit shall be clearly and permanently marked with the date of manufacture, class, production code, and manufacturer's trademark.

10. The Contractor and manufacturer shall exercise extreme care during transportation, handling, storing, and installation of the HDPE pipe to ensure that the pipe is not gouged or otherwise damaged in any way. The Contractor shall store the pipe with a cover to block ultraviolet light in accordance with the manufacturer's recommendations. If the HDPE pipe becomes gouged or otherwise damaged, before or during installation, it shall be replaced or repaired by the Contractor at no additional cost to the Owner.

2.3 UNDERDRAIN FILTER

- A. Pervious Backfill: Section 02300 - EARTHWORK.

2.4 DRAINAGE AND SANITARY STRUCTURES

- A. Precast Manhole and Catch Basin Sections: ASTM C 478.
- B. Precast Sections (for non-load bearing drainage structures other than manholes): ASTM C 139.

2.5 BRICK

- A. ASTM C32, Grade SS, 2-1/4 inches by 3-3/4 inches by 8 inches.

2.6 CONCRETE

- A. Concrete, General: Section 03300 - CAST-IN-PLACE CONCRETE.
- B. Cradles and Cradle-Arches: Class 4,000-3/4.
- C. Manholes and Other Load-Bearing Drainage Structures: Class 4000-3/4.

2.7 CEMENT MORTAR

- A. One part Portland cement, two parts sand by volume with sufficient water to form a workable mixture, mortar minimum strength of 3,000 psi.

2.8 FRAMES AND COVERS

- A. Manhole frame and cover shall be grey iron casting conforming to ASTM A48, heavy duty, with the word "DRAIN" or "SEWER", or other appropriate designation, embossed on the cover. Letter size shall be three inches (3 in.). Frame and cover shall have a minimum clear opening of 24 inches for drain manholes and have a minimum weight of 475 pounds. Sewer manhole covers shall have a minimum clear opening of 30 inches.
- B. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects affecting the strength and value for the service intended. The finished coating shall be tough and tenacious when cold and not brittle or with any tendency to scale off under reasonable temperature changes.

- C. Castings to be free from scale, lumps, blisters and sandholes. Machine contact surfaces to prevent rocking. Thoroughly clean and hammer inspect.
- D. Frames and covers to be as manufactured by E. L. LeBaron Foundry Co., Neenah Foundry Co., Campbell Foundry Company or equal. Frames and covers shall be capable of withstanding AASHTO H-20 loading unless otherwise indicated or specified.
- E. The Contractor shall furnish all manhole frames and covers conforming to the details shown on the drawings, or as herein specified. Frames and covers shall be of cast iron with diamond cover surface design. Manhole covers shall be machined to fit securely and evenly on the frame.

2.9 FRAMES

- A. Single catch basin frame and grate shall be EJ 5546Z / 5520M5 or approved equivalent with four flanges, or with three flanges for use with gutter inlet or abutting vertical curb. Frame and grate for catch basin with shallow cover shall be EJ 5525Z / 5520M5 or approved equivalent.
- B. Double catch basin frame and grate shall be EJ 5448Z / 5520M5 or approved equivalent, with four flanges, or with three flanges for use with gutter inlet or abutting vertical curb.

2.10 GRATES

- A. Single and Double Catch Basin Grates shall be cascade type, as manufactured by E. L. LeBaron Foundry Co., model L24SG18, by Neenah Foundry Co., by Campbell Foundry Co., or equal unless otherwise shown on the Drawings.

2.11 HOODS

- A. Catch Basin Hoods shall be as manufactured by E. L. LeBaron Foundry Co., model L-202, Neenah Foundry Co., Campbell Foundry Co., or equal.

2.12 NO DUMP CURB MARKERS

- A. No-dump markers shall be installed on all existing-to-remain or proposed catch basins and inlets within the project area. Curb markers shall be 4" diameter, 0.090 mil. thick, PVC laminate, with urethane dome, as manufactured by Das Manufacturing Inc., Duracast style.

2.13 FLEXIBLE MANHOLE SEALS

- A. Flexible manhole seals shall be "New Lok Joint Flexible Sleeve" by Interpace, "A-Lok Manhole Sleeve" by L & L Concrete Products, "Press Wedge II" by Pre-Seal Basket Corporation, or approved equal. Field applied seals shall be "K or N Seal" boot or equal. Manhole sleeves, gaskets and sealants shall be furnished complete with lubricants, stainless steel stops, inserts, clamps, etc.

PART 3 - EXECUTION

3.1 GENERAL

- A. Excavation. Excavate trenches as specified in Section 02300 - EARTHWORK.
- B. Bedding. Classes of bedding are defined in ASTM C12. Use class of bedding indicated; prepare trench and bedding as specified in ASTM C12. Place concrete for encasement against undisturbed soil.
- C. Pipe Laying. Lay all pipe in accordance with the manufacturer's written instructions. Additional requirements for specific types of pipe are included in subsequent articles herein.
- D. Structures. Construct manholes, junction chambers, inlets, wingwalls, and other related drainage structures in connection with the installation of pipe. Install or cut pipe flush with the inside face of structure walls.
- E. Protection
 - 1. Protect joint materials from the air and sun to prevent drying and other deterioration.
 - 2. Take precautions to prevent flooding of trench prior to backfilling.
 - 3. Do not allow free water to come in contact with pipelines until Portland cement joint and sealing materials have set for at least 24 hours.
- F. Backfill. Backfill trenches as specified in Section 02300 - EARTHWORK.

3.2 CRADLES

- A. Where gravel, crushed stone, or concrete cradles are indicated, provide bell holes in subgrade to permit uniform cradle depth beneath entire pipe length.

3.3 JACKING PIPE

- A. At locations indicated jack reinforced concrete pipe, steel casing pipe, fiberglass reinforced pipe or corrugated metal pipe into place between limits indicated.
- B. Strength, reinforcement, and gauge of pipe designated to be jacked will be determined for vertical loads only. Provide additional reinforcement or higher strength or heavier gauge pipe as necessary to withstand jacking pressure, at no additional expense to the Owner.
- C. Excavate for jacking pipe not more than 0.1 foot wider than outside limits of pipe. When material tends to cave beyond that limit, use a shield ahead of the first section of pipe. Backfill caving and excavation beyond that limit with sand or grout to fill voids.
- D. Sluicing and jetting will not be permitted.

3.4 INSTALLATION OF REINFORCED CONCRETE PIPE

- A. Placement: Lay pipe upgrade with bell or groove end uphill. Place circular pipe having elliptical reinforcement with minor axis of the reinforcement in vertical position.
- B. Backfilling: Except where an exfiltration/infiltration test is to be performed, backfill of culvert-pipe and siphon-pipe trenches may be completed while joint mortar is still plastic. Should joint mortar become set before placing backfill, do not commence backfilling within 16 hours of joining pipe sections.

3.5 INSTALLATION OF PVC PIPE

- A. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length. If a piece of pipe fails to meet this requirement for straightness, it shall be rejected and removed from the site. Any pipe unit or fitting discovered to be defective, either before or after installation, shall be removed and replaced with a sound unit.
- B. No pipe or fitting shall be permanently supported on saddles, blocking, or stones. Crushed stone shall be as specified in Section 02300 - EARTHWORK.
- C. Suitable bell holes shall be provided, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material. Special care shall be taken to hold the trench width at the crown of the pipe to the maximum indicated on the Trench Detail included in the Details Section of these specifications.
- D. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
- E. Pipe and fittings shall be installed to the lines and grades indicated on the Drawings. Care shall be taken to ensure true alignments and gradients.
- F. Before any joint is made, the previously installed unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object.
- G. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be checked to see that the rubber ring is properly seated. Apply lubricant to the spigot end only, paying particular attention to the bevel, in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer.
- H. Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.

- I. Details of gasket installation and joint assembly shall follow the directions of the manufacturers of the joint materials and of the pipe, all subject to review by the Engineer. The resulting joints shall be watertight and flexible.
- J. All premolded gasket joint polyvinyl chloride pipe of a particular manufacturer may be rejected if there are more than five unsatisfactory joint assembly operations or "bell breaks" in 100 consecutive joints, even though the pipe and joint conform to the appropriate ASTM Specifications as hereinbefore specified. If the pipe is unsatisfactory, as determined above, the Contractor shall, if required, remove all pipe of that manufacturer of the same shipment from the work and shall furnish pipe from another manufacturer which will conform to all of the requirements of these specifications.
- K. Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.
- L. After each pipe has been properly bedded, enough crushed stone shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes, provided for jointing, shall be filled with crushed stone and compacted, and then crushed stone shall be placed and compacted to complete the pipe bedding.
- M. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench. At all times pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs, or by other acceptable means.
- N. If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe. Pipelines shall not be used as conductors for trench drainage during construction. Install PVC pipe and fittings in accordance with manufacturer's printed instructions.
- O. Allowable Pipe Deflection: Pipe provided under this Specification shall be so installed as to not exceed a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe. Upon completion of a section of pipe, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer, and be reviewed by the Engineer. The section of pipe must be placed and backfilled for a minimum of 90 days before the deflection can be measured. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem without additional compensation.
- P. Cleaning: Care shall be taken to prevent earth, water and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering any existing pipe.

3.6 CONCRETE ENCASEMENT

- A. If pipe is indicated to be entirely or partly embedded in concrete, support and brace pipe in a manner that will prevent movement or displacement of pipe during testing and during placement and consolidation of concrete.

- B. Place concrete as specified in Section 03300 - CAST-IN-PLACE CONCRETE, being careful to tamp concrete under and around pipe without displacing pipe.
- C. Do not use earth form.

3.7 BACKFILL

- A. Partial Backfill Before Testing
 - 1. Deposit and compact backfill in four inch layers around bottom half of pipe and for full width of trench, leaving top half of pipe exposed.
 - 2. Deposit and compact additional backfill between joints, to a depth of 12 inches above top of pipe, leaving joints exposed.
- B. Final Backfill After Testing
 - 1. Backfill and compact as specified in Section 02300 - EARTHWORK, flush with finished grade. If permitted by the Engineer, surface of backfill may be slightly convex.
 - 2. Restore surface to its original condition or as required.

3.8 LEAKAGE TOLERANCES

- A. Gravity Lines. Maximum allowable leakage for any section or sections, or for the total lengths of pipe lines: 200 gallons per inch of diameter per mile per 24 hours.
- B. Force Mains: Zero leakage in 30 minutes at 150 percent of the maximum pressure that pump or ejector is capable of developing.

END OF SECTION

SECTION 024440

CHAIN-LINK FENCE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the furnishing and installation of chain-link fence and gates, of the following types:
1. Type I: Galvanized Steel
 2. Type II: Aluminum-Coated Steel Fabric with Galvanized Steel Posts, Hardware, and Fittings
 3. Type III: (not used)
 4. Type IV: Colored PVC-Coated Steel Fabric with Galvanized and Factory-Painted Steel Posts, Hardware, and Fittings
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 03300 – CAST-IN-PLACE CONCRETE
 2. Section 05500 – MISCELLANEOUS METALS
 3. Section 09900 – PAINTING
 4. Section 16450 – GROUNDING

1.2 SUBMITTALS

- A. Shop Drawings:
1. Include cross sectional dimensions of posts, braces, rails, fence fabric, fittings, accessories and gate frames; design of gates; and details of all gate hardware.
 2. Include a layout drawing showing the spacing of posts and location of all gates; abrupt changes in grade; and all corner, gate, anchor, end, and pull posts.
- B. Certificates. Submit certified test reports giving results of tests specified herein for zinc and vinyl coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with AASHTO M181, with the additions and modifications specified herein.
1. Aluminum alloy line, end, and corner posts, and top rail, may be substituted for galvanized steel at the Contractor's option.
 2. Aluminum Alloy: ASTM B221 for shapes, and B429 for pipe, Alloy 6061-T6. Pipe dimensions specified are the nominal pipe sizes per ASTM B429 Schedule 40. Coat portions of

posts to be embedded in concrete with two coats of an accepted coal-tar mastic, allowing 24 hours drying time between coats.

3. Steel pipe dimensions and weights: ASTM A120, Schedule 40. Dimensions specified are the nominal pipe sizes.
 4. Dimensions and weights specified herein are subject to a tolerance of plus or minus five percent.
 5. Zinc Coating: Minimum 2.0 ounces per square foot except where specified otherwise.
 6. Provide posts with accepted tops of same material as posts, so designed as to fit securely over post and carry top rail or cable; the base of top fitting shall carry an apron around outside of post.
- B. Line Posts
1. Steel, Five Feet and Shorter: 1-1/2 inch pipe; or 1.625 by 1.875 inch H column weighing 2.70 pounds per foot; or 1.625 by 1.875 inch C column weighing 2.20 pounds per foot.
 2. Aluminum, Five Feet and Shorter: 1.625 by 1.875 inch H column weighing 1.03 pounds per foot.
 3. Steel, Over Five Feet: 2 inch pipe; or 1.95 by 2.25 inch H column weighing 4.10 pounds per foot; for 1.70 by 2.25 inch C column with a weight of 2.66 pounds per foot.
 4. Aluminum, Over Five Feet: 2 by 2.25 inch H column weighing 1.24 pounds per foot.
- C. Gate Posts: Steel, minimum 3-1/2 inch pipe, except as otherwise specified in the Construction Specifications.
- D. End and Corner Posts
1. Steel, Five Feet and Shorter: 2 inch pipe, or 3.5 inch square C column weighing 5.163 pounds per foot.
 2. Aluminum, Five Feet and Shorter: 2 inch pipe.
 3. Steel, Over Five Feet: 2.5 inch pipe, or 3.5 inch square C column weighing 5.163 pounds per foot.
 4. Aluminum, Over Five Feet: 2.5 inch pipe.
- E. Top Rail, Cables, and Spring Tension Wire
1. Top Rail
 - a. Steel: 1-1/4 inch pipe, or 1.25 x 1.625 inch C section weighing 1.262 pounds per foot.
 - b. Aluminum: 1.25 inch pipe.
 - c. Couplings and Expansion Sleeves: Outside sleeve type, minimum six inches long.
 2. Cable: ASTM A475, 3/8 inch, seven-strand, common grade, Class A galvanizing.
 3. Cable attachments
 - a. Shoulder Eye Bolts: 5/8 inch diameter, of sufficient length to fasten to the post used.
 - b. Turnbuckles: Shackle end type, 1/2 inch diameter, with six-inch standard take-up and 3/8 inch diameter pins.
 - c. Thimbles: lightweight wire rope for use with 3/8 inch diameter cable
 - d. Wire Rope Clips: U-bolt diameter of 7/16 inch for use with 3/8 inch diameter cable.
 - e. Anchor Shackles: 3/8 inch diameter, 11/16 minimum distance between eyes, 7/16 inch pin diameter.
 - f. Seizing: 0.0181 inch diameter galvanized annealed iron wire.

4. Spring Tension Wire: Coil spring steel, 0.1770 inch diameter; base metal having a minimum tensile strength of 80,000 psi, galvanized with 1.6 ounces per square foot; or aluminum coated with 0.4 ounces per square foot.
- F. Braces and Tension Rods
1. Compression Braces: Same type and size as top rail.
 2. Tension Rods: 3/8 inch round rods with drop-forged turnbuckles or other approved type of adjustment.
- G. Fence Fabric
1. Type I, Galvanized Steel: ASTM A392, Size 9, Class 2 coating.
 2. Type II, Aluminum-Coated Steel: ASTM A491, Size 9.
 3. Type IV, PVC-Coated Steel: ASTM A392, Size 9, except with PVC coating in lieu of galvanizing.
 4. Selvages, all Types
 - a. Fabric 60 inches high and under: knuckled at both selvages.
 - b. Fabric over 60 inches high: knuckled at one selvage and twisted and barbed at the other.
- H. Fabric Band and Stretcher Bars
1. Fabric Band: Minimum 1/8 by 3/4 inch section.
 2. Stretcher Bars: Minimum 1/4 by 3/4 inch section.
 3. Aluminum Alloy Items: ASTM B221, 6061-T6.
- I. Tie Wire and Miscellaneous Items
1. Tie Wire: Galvanized or aluminum-coated 0.148 inch steel wire, or aluminum alloy conforming to ASTM B211, 1100-H14.
 2. Hog Rings: Galvanized or aluminum-coated 0.120 inch steel wire, or aluminum conforming to ASTM B221, 6061-T6. Aluminum coating: minimum 0.24 ounces per square foot.
 3. Post Clips: Galvanized or aluminum-coated 0.192 inch steel wire, or aluminum alloy conforming to ASTM B211, 1100-H14. Aluminum coating: minimum 0.30 ounces per square foot.
- J. Barbed Wire and Extension Arms
1. Barbed Wire: ASTM A121, 12-1/2 gauge, 4-point round barbs, Class 3 coating.
 2. Extension Arms: Projecting at an angle of approximately 45 degrees, fitted with clips or other means of attaching three strands of barbed wire, the top outside wire approximately 12 inches from the fence line and the other wires spaced uniformly between the top outside wire and the fence fabric.
- K. Gates
1. General. Furnish gates complete with necessary hinges, latches, and drop bar locking devices; corners shall be welded or fastened and reinforced with suitable fittings.
 2. Gates Frames, Six Feet and Under: 1-1/4 inch steel pipe or aluminum tubing.
 3. Gate Frames, Over Six Feet; 1-1/2 inch steel pipe or aluminum tubing.
 4. Cross-Trussing: 3/8 inch galvanized iron adjustable rods.

- L. Concrete: Section 03300 - CAST-IN-PLACE CONCRETE, Class 4000, 3/4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place posts at each corner, change of direction, abrupt change in grade, gate, and terminal, in addition to line and pull posts.
- B. Space line posts on not more than 10-foot centers. In determining the posts spacing, measure parallel to slope of finished grade. Place all posts in vertical position except in unusual locations where the Engineer may require otherwise.
- C. Where fencing is installed on the top of concrete structures, use galvanized sleeve and grout posts or install with suitable flange casings and galvanized anchor bolts. Set all other posts permanently in concrete.
- D. Coat aluminum posts with material specified for protection of dissimilar metals as specified in Section 05500 - MISCELLANEOUS METALS, from bottom to two inches above concrete prior to embedment, and touch-up such coated areas in accordance with requirements of Section 09900 - PAINTING, after concrete is cured. Similarly protect bottoms of aluminum anchor plates that will be in contact with concrete.
- E. Excavate post hole footings not smaller than 12 inches in diameter and 36 inches deep. Crown top of concrete to shed water, and allow to cure not less than 72 hours before proceeding with further work on the posts. Backfill posts with acceptable material placed in layers and thoroughly compacted. Embed galvanized steel eye bolts in the top of footings, adjacent to the posts, to receive the bottom tension wire.
- F. Brace end, corner, pull, and gate posts to the nearest line post, with diagonal or horizontal brace rails used as compression members, and with truss rods with turnbuckles used as tension members. Brace line posts horizontally and truss in both directions as required, at approved intervals.
- G. Fasten fabric to outer face of posts, except where a property owner's existing fencing occurs directly against and adjacent to the Client/Owner's fencing, fasten chain-link fabric to the inner face of posts. Stretch and securely fasten fabric to posts, rails, and top and bottom tension wire with either tie wires or metal bands. Stretch tension wires tight with turnbuckles spaced at not more than 1,000 foot intervals. Install bottom tension wire on straight grade between posts by excavating the high points of ground; in no case will filling of depressions be permitted. Fasten fabric to end, corner, pull, and gate posts with stretcher bar bands spaced at one foot intervals. Place fasteners at approximately 14 inch intervals on pipes and at approximately 18 inch intervals on tension wires. Insure that the bottom tension wire is installed so that the fence fabric selvage is not more than one inch from the surface of the ground or top of concrete, except where special closures at ground depressions are indicated. Run the bottom tension wire through eye bolts installed in the footing or top of wall at each post.
- H. Install barbed wire on extension arms as indicated. Pull each wire taut, and make entire assembly secure. Attach wire to end, corner, pull, and gate posts with stretching bands.

- I. Provide steel angle metal closures where finish ground surface is more than one inch below the bottom tension wire. Bolt steel angle to fence posts, and install the reinforcing rods and bracing members as approved. Install rods of accepted length vertically. Where drainage ditches cross the fence line, provide concrete ditch lining and steel reinforcing bar grille.
- J. Electrical Ground. Where a power line carrying more than 600 volts passes over fence, install ground rod at the nearest point directly below each point of crossing. Ground all substation fences and gates and perform other electrical grounding as indicated and as specified in Section 16450 - GROUNDING.

3.2 TOUCH-UP AND REPAIR WORK

- A. Remove and replace fencing which is improperly located or is not true to line, grade and plumb within tolerances as indicated.
- B. Repair damaged vinyl-coated components as recommended by the manufacturer.

END OF SECTION

SECTION 024600

FOUNDATION PILES – DRIVEN STEEL PILES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide all labor, material, equipment, and incidentals necessary to complete the Work specified in this Section.
- B. Scope of Work includes, but is not necessarily limited to, providing the following:

Foundation Piles

1.2 SUBMITTALS

- A. The Contractor shall submit the information specified herein to the Geotechnical Engineer for review. Unless otherwise specified, submittals shall be made not less than two weeks before the start of the work.
- B. Name and qualifications of the firm that will perform the pile installation.
- C. Shop Drawings:
 - 1. Shop drawings showing sizes, tip details, joint or splice details, pile coatings, and other items pertinent to pile design.
 - 2. A tabular summary of anticipated pile lengths at each pile location or other point of support.
 - 3. Shop Drawings showing the proposed pile driving frame illustrating that the frame will control the batter of the pile via contact at a minimum of two elevations and will not damage pile coatings.
- D. The attached PILE DRIVING EQUIPMENT DATA FORM, completed in every detail pertaining to the proposed pile driving system. The Geotechnical Engineer will review the proposed system, perform a wave equation analysis, and determine the penetration resistance criteria to be used for dynamic testing. The pile driving system shall not be mobilized to the site until it has been reviewed and accepted by the Geotechnical Engineer.
- E. Mill certificates stating the chemical composition, yield point, and ultimate strength of the steel

1.3 QUALITY ASSURANCE

- A. Except as noted elsewhere, Work shall conform to the latest edition of the following codes and standards:
 - 1. American Society for Testing and Materials (ASTM): the specifications and standards referred to herein, latest editions.
 - 2. American Welding Society (AWS) "D1.1 Structural Welding Code- Steel."
 - 3. American Concrete Institute (ACI): Building Code Requirements for Reinforced Concrete, ACI-318, current edition.

4. American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges, 17th Edition
 5. Maine Department of Transportation (MDOT): Standard Specification for Highways and Bridges, current edition.
 6. Maine Uniform Building and Energy Code (MUBEC) which is based on the International Building Code (IBC), 2015.
- B. Comply with all rules, regulations, laws, and ordinances of the State of Maine, the City of Wells, Maine Uniform Building and Energy Code, International building Code (IBC 2015), and of all other authorities having jurisdiction. All labor, materials, equipment, and incidentals necessary to make Work comply with such requirements shall be provided without additional cost to Owner. All welding shall be performed by operators qualified by tests as prescribed in the "AWS Standard Code for Welding in Building Construction". Evidence that welders meet qualification requirements shall be submitted to the Resident before welding is begun.
- C. Field Monitoring and Testing
1. The installation of production piles will not begin until the Dynamic Pile Load Testing is completed and the results are reviewed by the Geotechnical Engineer. Refer to Section 3.05 of this specification for details regarding the Dynamic Pile Load Testing
 2. The Contractor shall provide the Geotechnical Engineer free and safe access to the work at all times for the purpose of observing and testing the pile installation.
 3. No piles shall be driven to final penetration except in the presence of the Geotechnical Engineer.
 4. From time to time, inspection of welding and welds will be performed by an independent testing agency employed by the Owner. The Contractor shall fully cooperate with the agency to facilitate inspection, notifying it in advance when welding operations are to be performed. Welds that do not conform to applicable specifications shall be repaired as directed by the Resident.
 5. Certification of quality of pile materials to be used in the work shall be furnished, in a form acceptable to the Owner, at the time of delivery of materials to the site. Pile materials shall also be subject to on-site observation for conformance with specifications.
 6. Approvals given by the Resident or by the Geotechnical Engineer shall not relieve the Contractor of his responsibility for performing the Work in accordance with the Contract Documents.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. All material provided under this Section shall be delivered, stored, and handled so it is not lost, stolen, or damaged before installation in the Work. The Contractor at no cost to the Owner will replace any material that is lost, stolen, or damaged.
- B. The Contractor shall deliver piles at times and in sequence to assure continuity of pile driving.
- C. Piles shall be handled, transported, stacked and protected to prevent damage to the piling and the pile coating material.

1.5 JOB CONDITIOINS

A. Site and Subsurface Conditions

1. Geotechnical Reports have been prepared for the Project and are available. The Contractor is required to use these documents and perform additional geotechnical site investigations and design as necessary to complete their final design. Data presented in those reports present only the conditions at that specific location and at the time of exploration and shall not be interpreted as a warranty of subsurface conditions whether interpreted from written text, boring logs, or other data. Prior to submitting his bid, the Contractor shall review and understand the information contained in the boring logs. The boring logs are made available to the Contractor for information only and shall not be interpreted as a warranty of subsurface conditions
2. The Contractor shall protect adjacent property, public utilities, structures, and completed work, from damage associated with the pile driving operation. Damage due to pile driving shall be repaired by the Contractor at his own expense.

1.6 LINES AND GRADING

- A. The Contractor shall mark the pile locations and establish all elevations required. The Owner will provide a baseline and benchmark located on or close to the site. The Contractor shall be responsible for the maintenance and protection of all pile location marks and the benchmark
- B. The Contractor shall employ a Licensed Land Surveyor or a Licensed Professional Engineer, familiar with pile installation, who shall establish lines and levels. The Contractor shall be responsible for the correct location of piles, as well as keeping up-to-date records of the amount of uplift of individual piles and establishing actual pile locations. Locations of the centers of as-driven piles shall be shown on a drawing in relation to the design location and submitted to the Resident within two days after the individual pile or pile group is completed. Drawings shall include the following:
 1. Each pile identified by a separate number.
 2. Elevation of each top of pile prior to cutting, to nearest 0.1 foot.
 3. Deviation in inches, to the nearest 1/4 inch, from plan location at cutoff elevation.
 4. Batter direction and magnitude in inches per foot, to the nearest 1/8 inch.

PART 2 - PRODUCTS

2.1 PILE STEEL SECTION

- A. Pile Steel Section and Splices
 1. All driven pile shall be steel sections conforming to the design material type and grade. The pile shall be new and shall meet all tolerance specified by the manufacturer.
- B. Miscellaneous Driving Accessories: Pile points shall be used on all piles, and shall consist of APF Hard-Bite Points Model HP-7760-B, or approved alternate.
- C. Material Test Report: Material test reports shall be submitted certifying the items listed in this section.

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATIONS AND EQUIPMENT REQUIREMENTS

- A. The Contractor shall provide at least one fully equipped pile driving rig in full-time operation at the site during the work, and shall mobilize additional equipment, if necessary, to complete the work on schedule.
- B. The Contractor shall coordinate his pile driving operations with other work on the project.

3.2 EQUIPMENT

- A. Piles shall be installed with approved modern equipment. The proposed pile installation equipment and methods shall be subject to the approval of the Geotechnical Engineer and approval shall be secured before the equipment is mobilized to the site.
- B. Piles may be driven with a single acting, double acting, or differential acting steam or air hammer, or diesel hammer.
- C. The Contractor's pile driving system shall be submitted to the Geotechnical Engineer for review and acceptance prior to mobilization to the site. The driving system shall be capable of installing the piles to an ultimate capacity of 300 kips without exceeding the allowable driving stress (0.9 Fy, i.e. 90% of minimum yield strength of the steel), and with a final penetration resistance between 5 and 12 blows per inch.
- D. The use of followers will not be permitted.

3.3 INSTALLATION

- A. Driving
 1. As part of preparation for driving, each pile shall be marked at one-foot intervals along the entire pile length. In addition, the footage shall be marked and designated at five-foot intervals, starting from the tip of the pile.
 2. All piles shall be driven at the proper locations shown on the Drawings. Pile locations shall be checked during driving and appropriate measures taken, as necessary, to maintain the correct pile location.
 3. Each pile shall be driven until the resistance meets the final penetration resistance requirement determined by the Geotechnical Engineer's wave equation analysis, and revised based on dynamic pile testing. If abrupt refusal is encountered, driving may cease when there is less than ½ inch of penetration for 10 successive blows of the hammer.

In addition to the penetration resistance requirement, the piles shall reach an embedment of 26 feet. If piles achieve the required capacity at a lesser depth, the Geotechnical Engineer should be notified.

Where practicable, pile driving shall be continuous and without interruption for the final 20 feet of penetration.

4. Piles in a group shall be driven commencing in the center of the group and working toward the edge. All piles in any one group shall be driven before moving to other locations.
5. Immediately after a pile in a pile group is driven, the Contractor shall establish a reference point and its elevation on the pile for the purpose of checking uplift of the pile tip as additional piles are driven.
6. After all piles within the radius of uplift have been driven, the Contractor shall determine the elevation of the reference points on each of the piles in the group. If uplift of 0.04 feet or more has occurred, the pile shall be redriven to its original elevation, and deeper if necessary, to the specified final driving resistance. After redriving each pile, the Contractor shall reestablish the elevation of the reference point. Redriving shall be repeated as often as necessary until the measured uplift on any pile is less than 0.04 feet.
7. The radius of uplift is defined as the maximum distance between piles such that pile driving causes uplift of 0.04 foot or more in the affected pile. Survey instruments used to establish the reference elevations shall be carefully checked and adjusted as necessary to insure accurate readings. Uplift measurements shall be submitted to the Resident.

B. Obstructions

1. The Contractor shall make reference to the test boring data and available plans showing the site conditions.
2. If a production pile encounters an obstruction which will damage the pile tip or cause the pile to drift off location, the pile shall be pulled and the obstruction removed by auguring, drilling, or other approved methods, and the pile be re-driven.
3. Replacement of pile damaged by obstruction shall be the responsibility of the Contractor, at no additional cost.
4. Excavations abandoned because of obstructions shall be immediately backfilled with well-graded sand and gravel.

C. Splicing

1. All driven pile shall be steel sections conforming to the design material type and grade. The pile shall be new and shall meet all tolerance specified by the manufacturer.
2. Piles spliced by butt welds shall have 100 percent full penetration butt welds, producing a straight pile alignment through the splice and developing the full strength of the pile in both bearing and bending. Length of pile to be spliced shall be secured in proper alignment so that no eccentricity results.
3. All butt welding shall be performed in accordance with the applicable provisions of AWS D1.1/D1.1M:2010 and/or AWS D1.5M/D1.5:2008. Testing of butt welds at pile splices shall be performed as per the Design Documents. Butt welds, which do not conform to applicable specifications shall be repaired at no additional cost as directed by the Geotechnical Engineer.
4. Make splices before starting driving operation, if possible. If a welded splice is required during the driving operation, make the splice when the top of the driven pile portion is at least three feet above the ground, to permit inspection of the welded connection during welding and during subsequent driving. Spliced lengths shall be at least 10 feet or greater in length.
5. Welded spliced piles shall not be driven until the weld has been inspected and accepted by the Contractor's representative.
6. Welding shall be in accordance with provisions of the latest issue of the American Welding Society (AWS) code.
7. Welds which do not conform to specifications shall be gouged and repaired as directed by the inspector.
8. Mechanical drive-fit splices shall not be used.

D. Cutting off Piles

1. Pile tops shall be cut off square within one-half inch of the elevations shown on the Drawings. The pile cut-offs shall become the property of the Contractor and shall be removed from the site.

3.4 TOLERANCES AND CRITERIA FOR ACCEPTANCE

- A. Piles shall be driven until the average penetration resistance (given in blows per inch) for the final six (6) inches of driving exceeds the required penetration resistance determined by the Geotechnical Engineer's wave equation analysis, and as refined based on dynamic testing. If abrupt refusal is encountered, driving may be terminated when the penetration is less than one-half inch for ten (10) successive blows. In addition, piles shall be driven so that the pile has at least 26 feet embedment below the bottom of foundation.

PILES THAT DO NOT ACHIEVE BOTH THE REQUIRED DEPTH OF PENETRATION AND THE REQUIRED PENETRATION RESISTANCE WILL BE REJECTED.

The Geotechnical Engineer will review the driving criteria with respect to the Dynamic Load Test results. The driving criteria including the required penetration resistance may be revised by the Geotechnical Engineer at that time, or if other circumstances warrant.

- B. A template shall be used to control pile location. Piles shall be driven as close as practicable to the plan location. The maximum lateral deviation permitted from the correct location at cut-off elevation will be one inch for single piles and groups of piles prior to removal of the template, and will be three inches after removal of the template. The maximum deviation permitted from design cut-off elevation will be one-half inch. The vertical alignment shall not vary from plan alignment by more than one-quarter inch per foot of depth below cutoff. The alignment of batter piles shall not vary from the design batter by more than one-half inch per foot of depth below cutoff.
- C. Piles that are damaged below cut-off elevation during driving will be rejected. If upon comparing pile performance during driving with that of other driven piles, and based on his knowledge of the subsurface conditions, the Geotechnical Engineer determines that a pile has been unacceptably damaged, he may reject the pile.
- D. Except as specified under "Obstructions", piles that are rejected because of damage, mislocation or misalignment, or failure to meet the driving criteria, shall be cut off below the limits of the structure and abandoned, and additional piles shall be driven as directed by the Resident.
- E. Piles rejected in accordance with the provisions of these Specifications and which result, in the judgment of the Resident, from the Contractor's violation of the Specifications or his other error, will not be paid for.
- F. Whenever, in the judgment of the Resident, misalignment or rejection of a pile or piles, caused by the Contractor's violation of the specifications or his other error, necessitates structural redesign, the cost of such redesign shall be deducted from sums otherwise due to the Contractor under the contract. If the redesigned pile cap requires greater quantities of steel and concrete, as compared with the quantities required for the pile cap as originally designed, the additional cost shall also be deducted from the contract price.

- G. The installation of replacement piles and other corrective measures shall in all cases be in accordance with designs approved by the Resident.

3.5 DYNAMIC PILE LOAD TESTING

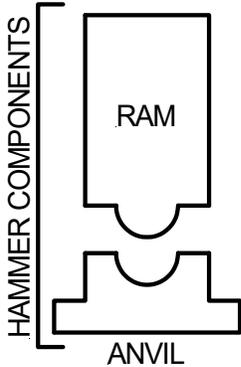
- A. The Geotechnical Engineer shall provide Dynamic Load Testing services, and shall test the first production pile on each side of the railroad. The Contractor shall cooperate fully with the Dynamic Testing Consultant to complete the tests.
- B. Drive a minimum of one DLT pile on each side of the railroad, to evaluate driving experience and lengths. Each test pile shall be instrumented with a Pile Driving Analyzer (PDA) for at least the last five feet of driving. The Geotechnical Engineer operating the PDA shall be paid for by the Owner. The PDA equipment shall be PAK Model Pile Driving Analyzer by Pile Dynamics, Inc., Cleveland, Ohio, or equivalent. The dynamic load testing shall be performed in accordance with ASTM D 4945 *High Strain Dynamic Testing of Piles*.

Each DLT pile shall be tested at end of initial drive, and at the beginning of restrrike approximately one day after its initial drive. CAPWAP analyses (4 total) shall be performed on the driving records of the DLT piles at end-of-initial driving, and at 24-hour redrive. The Geotechnical Engineer shall submit a dynamic pile testing report which shall include a summary of the test data, recommended driving criteria, anticipated driving stresses and a tabulation of the pile shaft resistances as determined by the CAPWAP analyses.

- C. DLT piles shall be the same size and driven with the same equipment as the production piling at the site. Accepted DLT piles may be used in the work.

END OF SECTION

Project/Bridge: _____ Town: _____
 WIN: _____ Fed. Proj. No: _____ Bridge No: _____
 Contractor: _____ Pile Driving Sub: _____



HAMMER

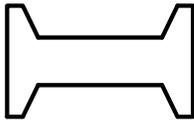
Manufacturer: _____ Model: _____
 Hammer Type: _____ Serial No: _____
 Max Energy: _____ (ft-lbs) @Stroke Length: _____ (ft)
 Ram Weight: _____ (lbs)

Modifications: _____



HAMMER CUSHION

Material: _____
 Thickness: _____ (in.) Area: _____ (in.²)
 Modulus of Elasticity (E): _____ (psi)
 Coefficient of Restitution (e): _____



DRIVE HEAD

- Helmet
- Bonnet
- Anvil Block
- Pile Cap

Weight: _____ (lbs)



PILE CUSHION

Material: _____ Thickness: _____ (in.)
 Modulus of Elasticity (E): _____ (psi)
 Coefficient of Restitution (e): _____



PILE

Pile Type: _____
 Length (in Leads): _____ (ft)
 Weight/Length: _____ (lbs/ft) Diameter: _____ (in.)
 Wall Thickness: _____ (in.) X-Section Area: _____ (in.²)
 Maximum Factored Load: _____ (kips)
 Required Resistance: _____ (kips)
 Splice Description: _____
 Pile Tip Description: _____
 Submitted by: _____ Date: _____
 Telephone #: _____ Fax #: _____

Figure 1- Pile and Driving Equipment Data Form. Form can be found on the Department Website

SECTION 025130

BITUMINOUS CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the construction of bituminous concrete pavement on prepared subgrade or aggregate subbase or base course, on bridges, and on existing pavement, to the lines, grades, compacted thickness, and cross sections indicated.

1.2 QUALITY ASSURANCE

- A. The Owner reserves the right to perform inspections and testing at the plant and in the field at any time during the execution of work.

1.3 QUALITY CONTROL

- A. The contractor shall engage the services of a qualified independent testing agency approved by the Owner to perform quality-control testing in the field.

B. Job Mix Formulae

1. Establish the job mix formula in accordance with the requirements of the MaineDOT Standard Specifications, dated March 2020 or the latest version. Tolerances for the job mix formula should be in accordance with the MaineDOT Standard Specifications as well.
2. Should a change of sources of materials be made, furnish a new job mix formula for approval before using the new material.
3. Two or more job mix formulae may be approved for a particular plant; however, only material conforming to one job mix formula will be permitted to be used on any given day. If the Contractor elects to furnish bituminous concrete from more than one plant, the job mix formulae shall be adhered to by all plants.
4. When unsatisfactory results or other conditions make it necessary, the Engineer may establish new job mix formulae.

C. Methods of Sampling and Testing

1. Performance Graded Asphalt Binder
 - a. Viscosity: ASTM D4402.
 - b. Dynamic Shear: AASHTO TP5.
 - c. Flash Point: AASHTO T48.
 - d. Rolling Thin Film Over Test: AASHTO T240.
 - e. Mass Change %: AASHTO T240.
 - f. PAV Aging: AASHTO PP1.
 - g. Specific Gravity: ASTM D 3142.
 - h. Creep Stiffness and M-Value: AASHTO TP1.
2. Cutback Asphalt
 - a. Viscosity: ASTM D 2170.

- b. Flash Point: ASTM D 3143.
- c. Distillation: ASTM D 402.
- d. Water in Asphalt: AASHTO T55.
- e. Specific Gravity: AASHTO T228.
- 3. Emulsified Asphalt: ASTM D 977.
- 4. Mineral Aggregates and Filler:
 - a. Sieve Analysis, Aggregates: ASTM C 136.
 - b. Sieve Analysis, Mineral Filler: ASTM D 242.
 - c. Unit Weight of Aggregate: ASTM C 29.
 - d. Material Passing No. 200 Sieve: ASTM C 117.
 - e. Abrasion of Coarse Aggregate: ASTM C 131.
 - f. Soundness of Aggregates: ASTM C 88.
 - g. Specific Gravity, Coarse Aggregate: ASTM C 127.
 - h. Specific Gravity, Fine Aggregate: ASTM C 128.
 - i. Specific Gravity, Mineral Filler: AASHTO T100 to T133
- 5. Bituminous Concrete Mixtures:
 - a. Density: AASHTO T166.
 - b. Compaction: ASTM D 2950.

D. Composition and Compaction Acceptance Tests

- 1. Where plant inspection is maintained, bituminous concrete will be acceptable for use if the specified tests from samples obtained at the production plant indicate conformance to the approved job mix formula.
- 2. For determination of pavement density, perform in-place density testing by the Nuclear Density Method, ASTM D 2950.
- 3. The Owner may also require bituminous cores to determine in-place density.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials used in bituminous concrete pavement shall conform to MaineDOT Standard Specifications, dated March 2020 or the latest version, specifically within Sections 400 and 700.
- B. Performance-Graded Asphalt Binder (PGAB) that has not been modified with polymer shall conform to the requirements of AASHTO M 320. Polymer modified binder shall meet the requirements of AASHTO M 332 and AASHTO R 92. Performance-Graded Asphalt Binder shall not contain re-refined engine oil bottoms (REOB).
- C. Bituminous Emulsions
 - 1. Use of all emulsified asphalt shall comply with all Department of Environmental Protection (DEP) regulations regarding maximum amount of oil distillate, seasonal limitations, etc.
 - 2. Asphaltic Emulsions: AASHTO M140, grade as indicated.
 - 3. Cationic Emulsified Asphalt: AASHTO M208, grade as indicated.

4. Anionic emulsified asphalt grading RS-1h shall conform to the requirements outlined in MaineDOT Standard Specifications Section 702.04.
5. For emulsified asphalts, the Contractor shall arrange for the Supplier to furnish a Certificate of Analysis to the Owner or other representative.
6. Emulsified Asphalt Sealing Compound: Emulsified asphalt sealing compound shall be an approved commercially prepared product manufactured for specific protective coating, colored as required. It shall contain fillers, pigments and sand or fibrous materials suspended in a suitable emulsified asphalt or tar. It shall be of such consistency that it can be applied at atmospheric temperatures and capable of being easily diluted with the addition of water and mixed by hand stirring at the site of application.

D. Coarse Aggregate

1. Coarse aggregate, that material retained on the No. 4 sieve, shall be crushed stone or crushed gravel and, unless otherwise stipulated, shall consist of clean, tough, durable fragments free from an excess of soft or disintegrated pieces and free from stone coated with dirt or other objectionable matter. Coarse aggregate shall not exceed an absorption of 2.0 percent by weight as determined by AASHTO T 85. Gradation:

E. Fine Aggregate

1. Fine aggregate, material that passes the No. 4 sieve, shall consist of natural sand, manufactured sand, or a combination of these. It shall consist of hard, tough grains, free from injurious amounts of clay, loam, or other deleterious substances. Fine aggregate shall not exceed an absorption of 2.3 percent by weight as determined by AASHTO T 84.

PART 3 - EXECUTION

3.1 PLANT REQUIREMENTS

- A. General: The plant used in the production of bituminous concrete shall comply with AASHTO M156, subject to the following additional requirements.
- B. Plant Scales
 1. Scales for measuring materials into the mixtures shall be springless dial type and shall be of standard make and design. Scale graduations and markings shall be plainly visible and dials shall be so located as to be easily readable from the operator's normal work station by direct sight or through repeating dials. Parallax effects shall be reduced to the practical minimum with clearance between indicator index and scale graduations not exceeding 0.06 inch. Dials shall be equipped with a full complement of adjustable index pointers for marking the required weight of each material to be weighed into the batch.
 2. Digital scales will be either electric/mechanical (load cell and lever system) or fully electronic (all load cell). Digital indicators shall be of standard make and design. Scale graduations and capacity shall be plainly visible on the faceplate of the indicator, if panel mounted. If the unit is of desktop or wall-mount variety, a data sticker shall be located on the side of the unit.

Indicators must be located as to be easily readable from the operator's normal workstation by sight.

3. Bitumen scales shall be accurate to 0.05 percent, have minimum graduations not greater than 0.025 percent, and shall be readable and sensitive to 0.0125 percent or less. Scales for any weigh box or hopper shall be accurate to 0.5 percent, have minimum graduations not greater than 0.5 percent and shall be readable and sensitive to 0.25 percent or less. The preceding percentages for both bitumen and aggregate scales are based on the maximum total batch weight of the mixtures.

C. Testing of Scales

1. All plant scales, including truck scales, shall be tested at the expense of the Contractor by a competent scale technician as follows:
 - a. Annually prior to use in Owner work.
 - b. At intervals of not more than 90 calendar days.
 - c. At any time ordered by the Engineer.
2. A cradle or platform approved by the Engineer for each scale and at least ten standard fifty-pound test weights shall be provided for testing scales whenever directed by the Engineer. The use of a set of test weights for two or more plants will be permitted only when they can be made readily available with no more than an hour's notice.

D. Automated Batching

1. Automatic proportioning. Batch type mixing plants shall be equipped with approved automatic proportioning devices. Such devices shall include equipment for accurately proportioning batches containing the various components of the mixture by weight in the proper sequence and for controlling the sequence and timing of mixing operations. Interlocks shall be provided which will hold or delay the automatic batch cycling whenever the batched quantity of any component is not within the specified weight tolerance, when any aggregate bin becomes empty or when there is a malfunction in any portion of the control system. The weight setting and time controls shall be so equipped that they may be locked when directed by the Engineer.
2. Automatic Recordation. Recordation equipment shall be provided. Each recorder shall include an automatic printer system. The printer shall be so positioned that the scale dial and the printer can be readily observed at one location by the plant inspector. Use of repeating dials or an additional printer to achieve this condition will be permitted. The printer shall print, in digital form, on a delivery ticket the following data:
 - a. Date mixed.
 - b. Time of batching.
 - c. Tare weight of aggregate weigh box.
 - d. Tare weight of bitumen weigh bucket.
 - e. Accumulative weights as batched for each bin. (Total of last bin will be aggregate total).
 - f. Weight of bitumen.
 - g. Total weight of mix in truck (Pay weight). This printed ticket shall be used in lieu of truck scale weights.
3. Equipment Failure. If at any time the automatic proportioning of recording system becomes inoperative, the plant will be allowed to batch materials manually for a period not in excess of two working days. Manual batching for longer periods will require written permission of the Engineer.
4. Batching Controls
 - a. The batching controls shall meet the following delivery tolerances with respect to the various components weighed in each batch:

- 1) Tare Weight of Aggregate Weigh Box: + 0.5 percent of total batch weight.
 - 2) Tare Weight of Bitumen Weigh Bucket: + 0.1 percent of total batch weight.
 - 3) Individual Aggregate Components: + 1.0 percent of total batch weight.
 - 4) Combined Aggregate Components: + 1.5 percent of total batch weight.
 - 5) Mineral Filler: + 0.5 percent of total batch weight.
 - 6) Asphalt: + 0.1 percent of total batch weight.
- b. The total weight of the batch shall not vary more than plus or minus 2 percent from the theoretical design weight.
 - c. If directed by the Engineer, provisions shall be made for locking controls against tampering.

E. Plant Laboratory

1. A building shall be furnished at the site of the producing plant suitable for the housing and use of equipment necessary to carry on the various tests required and for recording and processing test results. This building shall be for the exclusive use of the Engineer or his representatives for testing and recording purposes.
2. The building shall have a minimum floor area of 100 square feet; the least dimension to be 6 feet. Windows and doors shall be adequately screened; satisfactory lighting, heating and water shall be supplied. A table, chairs, desk and work bench shall be provided. Provision shall be made for the safe performance of extraction test determinations by providing an adequate exhaust fan and suitable means of disposing of used solvent and other waste.
3. If the Engineer permits, the plant laboratory may be part of another building in which case it shall be entirely partitioned off from the remainder of such building.
4. Testing equipment shall be furnished as follows and installed in the building for use in testing the materials and mixtures supplied by the Plant for the work:
 - a. One Approved Rotary Extractor.
 - b. One Coarse Aggregate Sieve Shaker, power driven with a minimum clear sieve area of 324 square inches. The shaker shall be attached to a firm anchorage.
 - c. One each of the following square opening screens for coarse aggregate shaker: 2 inch, 1-1/2 inch, 1 inch, 3/4 inch, 1/2 inch, 1/8 inch, No. 4 and No. 8.
 - d. One Fine Aggregate Sieve Shaker, power driven and independent of the coarse aggregate shaker, for eight inch minimum diameter sieves.
 - e. One each of the following standard eight inch minimum diameter square opening sieves: 3/4 inch, 1/2 inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, No. 50, No. 100, and No. 200, with pan and cover.
 - f. One Sample Splitter with a minimum capacity of one cubic foot. It shall be the clam shell type and the chute width shall be adjustable from a minimum of 1/2 inch up to 2 inches.
 - g. One Solution Balance, 20 kilogram capacity, weighing directly to 1 gram, with two weighing beams and a taring beam; tare capacity to be 2 kilograms; weighing beams to read 1000 grams by 100 gram divisions and 100 grams by 1 gram division. Additional matching weights (one 1 kg., two 2 kg., one 5 kg., and one 10 kg.) shall be provided to fulfill the capacity of 20 kilograms. The platform to be 11 inches in diameter.
 - h. One Approved Scale with a minimum capacity of 2000 grams and with a sensitivity of 0.50 grams
 - i. Two Approved Dial Type Thermometers, range 50 degrees F. to 500 degrees F.
 - j. One Approved Hot Plate
5. Approval of a plant will be contingent upon approval of the aforementioned requirements for Plant Laboratory, including the building and appurtenances, furnishings, facilities including heat, light, power and water, the testing equipment, and any other incidentals.

- F. Sampling facilities. Adequate and convenient sampling facilities shall be provided to allow the Inspector to obtain representative samples from the full width and depth of the discharge area of each aggregate bin. The sampling tray shall be structurally supported during the sampling operation. Access to the sampling facilities shall be provided requiring no more difficulty than that to climb a ladder leading to a secure platform with railings.
- G. Inspection. The Engineer or an authorized representative shall have access at any time to all parts of the plant for:
 - 1. Inspections of the conditions and operations of the plant.
 - 2. Confirmation of the adequacy of the equipment in use.
 - 3. Verification of the character and proportions of the mixture.
 - 4. Determination of temperatures being maintained in the preparation of the mixtures.
 - 5. Inspection of incidental related procedures.

3.2 PREPARATION OF MIXTURES

- A. Preparation of Asphalt Cement. Place bituminous materials in the mixer at a temperature between 275 and 375 degrees F., as directed.
- B. Preparation of Mineral Aggregate. Thoroughly dry and heat aggregates before placing them in the mixer. Control the temperature of the aggregates so that the temperature of the complete mixture shall be within the range specified in paragraph C. below.
- C. Preparation of Bituminous Concrete Mixtures. Combine the heated and dried aggregates and mineral filler and convey them into the mixer in the proportionate amounts of each size required to meet the job mix formula. After these materials have been mixed for the specified dry-mixing time, add the asphalt cement and mix for the specified wet-mixing time. Measure asphalt cement by weight or by an approved metering device. The temperature of the mixture when discharged shall be between 275 and 325 degrees F.

3.3 TRANSPORTATION AND DELIVERY OF MIXTURES

- A. Vehicles for transportation of mixtures from the plant to the jobsite shall be clean of all foreign materials, tight, and evenly and lightly coated with a suitable thin oil or approved soap solution. No excess of lubricant shall be allowed to accumulate in low spots in the body. When necessary, vehicles shall be insulated so that the mixture is delivered for placement at the proper temperature.
- B. Arrange dispatching of trucks from the plant so that all material which is delivered to the jobsite during any day shall be placed and shall have received final compaction before nightfall of the same day, unless satisfactory artificial light is provided.
- C. Do not transport mixtures such a distance that segregation of the ingredients takes place or that any crust is formed on the top, bottom, or sides of the mixture which will not crumble or flatten out when the mixture is dumped or which might otherwise be deleterious to the mixture in place on the work.
- D. During transportation of the mixture from the plant to the spreader at the jobsite, keep the mixture fully covered at all times with canvas or other suitable material of sufficient size and thickness to furnish complete protection.

E. Deliver the mixture to the jobsite at a temperature governed by the air temperature in the shade and away from artificial heat, as follows with a tolerance of plus or minus 20 degrees F.:

1. Normal Layered Construction:

| Air Temperature | Delivered Mix Temperature |
|------------------------|---------------------------|
| 35 degrees F. | 300 degrees F. |
| 40 degrees F. | 290 degrees F. |
| 65 degrees F. | 280 degrees F. |
| 90 degrees F. and Over | 275 degrees F. |

2. Deep Lift Paving (3 inches and over), Base and Binder Courses only:

| Air Temperature | Delivered Mix Temperature |
|------------------------|---------------------------|
| 35 degrees F. | 280 degrees F. |
| 40 degrees F. | 270 degrees F. |
| 65 degrees F. and over | 260 degrees F. |

3.4 PRIME COAT (OR TACK COAT)

- A. Where an existing hardened surface is used as a base for new pavement, or elsewhere where the surface to receive bituminous pavement is, in the Engineer's judgment, unsatisfactory to receive the pavement, give the surface a prime coat of bituminous material of the kind and grade indicated or directed. Where unsatisfactory conditions, requiring application of prime coat, are due to the fault of the Contractor, provide the prime coat at no additional expense to the Owner.
- B. Clean the existing surface of all foreign matter and loose material before applying prime coat. Apply the prime coat by mechanical means at the rate indicated or directed.

3.5 SPREADING AND FINISHING

A. General

1. Place bituminous concrete in courses as indicated.
2. When an existing surface or new base, upon which the bottom course is to be laid, contains unsatisfactory irregularities, in the Engineer's judgment, eliminate such irregularities by placing and compaction of mixture, so as to furnish a surface with true contour and grade before placing any specified bottom course.
3. Paint thoroughly the contact surfaces of bridge curbing, manholes, catch basins, and other appurtenant structures in pavement, with a thin coating of bitumen immediately prior to placing any mixture against them.
4. Give special attention to proper testing of the surface of each course with a straightedge. Finished surfaces shall be even and uniform throughout.
5. Remove and replace with new mixture any mixture which becomes loose or broken, mixed with dirt, or defective in any way. Finish and compact the repaired area to conform to the surrounding area. Remove and replace areas of one square foot or more showing an excess of bitumen.

6. No mixture shall be placed unless the breakdown and intermediate rolling can be completed by the time the material has cooled at 175 degrees F., and provided that the density of the pavement attains at least 95 percent of the laboratory compacted density.

B. Spreading and Finishing Equipment

1. The equipment for spreading and finishing shall be mechanical, self powered pavers, capable of spreading and finishing the mixture to line, grade, width, and crown by means of fully automated controls for both longitudinal and transverse slope.
2. The pavers shall be equipped with hoppers and distributing screws of the reversing type to place the mixture evenly in front of adjustable screeds. They shall be equipped with a quick and efficient steering device and shall have reverse as well as forward traveling speeds.
3. The pavers shall employ mechanical devices such as equalizing runners, straight edge runners, evener arms or other compensating devices to adjust the grade and confine the edges of the mixture to true lines. They shall be capable of spreading the mixture without segregation in layers to the depths and widths required. They shall be equipped with blending or joint leveling devices for smoothing and adjusting all longitudinal joints between adjacent strips or courses of the same thickness.
4. The screed shall be adjustable for profile and shall have an indicating level attached.
5. An approved device will be required for heating the screed to the temperature required for the laying of the mixtures without pulling or marring.
6. The term "screed" includes any "strike-off" device operated by cutting, crowding, or other practicable action, which is effective on the mixtures at permissible workable temperatures without tearing, shoving, or gouging and which produces a finished surface of the evenness and texture required.
7. The pavers employed on projects requiring in excess of 15,000 tons shall operate by the use of a sensing grid for operation to a stringline and matching shoe for joints.
8. The paver shall be provided with a "ski" which may be employed for paving on the previously laid bituminous concrete base, or binder as directed or permitted by the Engineer.
9. The paver employed on deep lift construction shall be capable of satisfactorily feeding the mix without intermittent stopping during the discharge of the mix from the trucks into the paving machine.
10. If during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other permanent blemishes in the pavement which are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and other satisfactory spreading and finishing equipment shall be provided.
11. Complete all compaction rolling before the bituminous concrete temperature drops below 185 degrees Fahrenheit.

C. Machine Spreading

1. Deposit mixtures in the approved mechanical spreader, spread immediately, and strike off in a uniform layer to the full width required and to such depth that each course, when compacted, shall have the required thickness and shall conform to the indicated grade and cross section contour.
2. Deposit mixture in the center of the hoppers, exercising care to avoid overloading and spilling. Operate the pavers, while the mixture is being spread, at a speed which will produce a uniform surface texture.
3. Immediately after each course is screeded and before roller compaction is started, check the surface, adjust any irregularities, remove accumulation from the screed by rake or lute, and remove and replace any unsatisfactory spots in the course. Correct irregularities in line and

grade along outside edges by addition or removal of material before the edge is rolled. Indiscriminate casting of mix on the new screeded surface, where irregularities are not evident, will not be permitted.

4. All edges shall be true and uniform.

D. Hand Spreading

1. Spreading by hand methods will be permitted only for particular locations in the work which because of irregularity, inaccessibility or other unavoidable obstacles do not allow mechanical spreading and finishing.
2. When hand spreading is permitted, place the mixture by dumping on approved steel dump sheets outside the area upon which it is to be spread; or by other approved methods. Immediately thereafter, distribute the mixture into place by means of hot shovels, and spread it with hot rakes or lutes in a loose layer of uniform density and correct depth. Tines of the rakes shall be not less than 1/2 inch longer than the loose depth of mixture, and spaces between tines shall be not less than 1 inch.
3. Do not dump loads faster than they can be properly handled by the shovelers, and do not distribute the dumped load faster than it can be properly handled by the rakers. Rake carefully and skillfully to avoid segregation and so that, after the first passage of the roller over the raked mixture, no back patching will be necessary.

3.6 COMPACTION

A. Compaction Equipment

1. After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers of approved design and weight per inch width of roller. The rollers shall be steel-wheeled supplemented with pneumatic-tired rollers where required, or where permitted, vibratory rollers.
2. Steel wheel rollers for initial and intermediate rolling shall have a weight of not less than 240 pounds per inch width of tread; for top course, minimum weight shall be 285 pounds per inch width of tread.
3. Pneumatic-tired rollers, when conditions warrant, shall be provided with devices capable of varying tire pressures. When the mixture being spread by each paver requires more than the minimum number of steel wheel rollers, at least one of the additional rollers for each paver shall be a pneumatic-tired roller, except where the use of a vibratory roller is permitted. When using a pneumatic-tired roller, care shall be taken that initial rolling by the steel wheel roller be restricted to one pass where upon the pneumatic-tired roller shall immediately follow the initial steel wheel rolling.
4. Vibratory steel drum rollers shall not be used on top course mix or structures. The machine shall have a device registering the number of vibrations per minute and a tachometer shall be provided to the Engineer in order to check the operation of the roller.
5. The V.P.M. on base and binder course material shall be a minimum of 1400 V.P.M. and a maximum of 1500 V.P.M., or in accordance with the recommendations of the manufacturer, when approved by the Engineer.
6. The vibratory roller shall be operated with the vibrating drum in the direction of the paver and the vibrating action of the roller shall be completely shut off during change of direction and care exercised to start this action only when the roller is in motion. In order to prevent creeping and aggregate crushing during rolling of layered pavement, care shall be taken not to exceed one pass in the direction of the paver with vibrator in action and one return in a static condition and

for deep lift pavements these passes shall not exceed two operations in each direction, except that the number of vibratory passes in either direction may be varied in order to obtain the required density.

7. A smoothing roller of either the pneumatic-tired or steel wheeled type shall be used immediately behind the last pass of the vibrating roller. The use of a vibratory roller may be suspended by the Engineer if, in his opinion, unsatisfactory results are being obtained and no further mix shall be spread until a sufficient number of approved rollers are on the project to satisfy the compaction requirements.
8. A plate shall be attached to each roller which shall show the ballasted and unballasted weight per inch width of tread.
9. The number of rollers and passes required shall be governed by the compaction results; however, at least one steel roller shall be provided for each paver employed on the paving operation. This is independent of the requirements of the pneumatic-tired roller.

B. Compaction Procedures

1. Roll the mixture longitudinally, diagonally, and transversely as may be necessary to produce the required contour for surface. Start longitudinal rolling at the side and proceed toward the center of the pavement, except on superelevated curves start at the low side and progress to the high side, overlapping on successive trips by at least 12 inches.
2. Continue the rolling so that all roller marks, ridges, porous spots, and impressions are eliminated and the surface has the required contour and grade. Maintain the motion of the rollers at all times slow enough to avoid any displacement of the hot mixture. Correct any displacement or marring of the surface resulting from reversing the direction of the roller or from any other cause.
3. To prevent adhesion with the mixture, keep the wheels of steel rollers lightly moistened with water. Excess water or oil for this purpose will not be permitted.
4. To prevent "rolloff" of the pavement edges and longitudinal joints on deep lift paving, leave the outer eight inches of the deep lift mixture unrolled until the temperature of the mix ranges between 150 and 180 degrees F., whereupon compact it with a steel roller.
5. Along curbs, structures, and all places not accessible with a roller, compact the surface thoroughly with mechanical tamping devices, smooth and true to established line, grade, and contour.
6. The densities of compacted bituminous concrete shall not be less than 95% of the density obtained from laboratory compaction of a mixture composed of the same material in like proportions or 92% maximum theoretical density of said mixture.

3.7 JOINTS

- A. Place mixture as nearly continuously as possible. Pass the roller over the unprotected end of newly placed mixture only when the placing of the course is to be discontinued for such length of time as will permit the mixture to attain initial stability. In all such cases, including the formation of joints as herein specified, provide for proper bond with the new surface for the full specified depths of the courses.
- B. Maximum length of longitudinal joint shall be such that the temperature of the mixture at the joint shall not be less than 150 degrees F. when the abutting mixture is placed.
- C. Make longitudinal and transverse joints in a careful manner, well bonded and sealed, true to line and grade. Where directed, cut back longitudinal and transverse joints to expose the full depth of the

course and, when laying of the course is resumed, paint the exposed edge of the joint with a thin coat of bitumen. Carefully rake the new mixture against the joint, then thoroughly tamp and roll.

- D. In making joints along any adjoining edge such as curb, gutter, or an adjoining pavement, and after the mixture is spread by the paver, place by hand just enough of the hot material to fill any space left open. Set up these joints with the back of a rake at the proper height and level to receive the proper compaction.
- E. Stagger longitudinal joints in successive courses so that there is a minimum of one foot overlap between longitudinal joints in adjacent courses.
- F. Overlap the rolling of successive widths of courses so as to leave smooth, uniform joints and cross sections.

3.8 FIELD QUALITY CONTROL

- A. Test the plane of the finished surfaces of base, binder, and surface courses with a 16-foot straightedge, except use a 10-foot straightedge on vertical courses and on the top course of resurfaced streets which contain manhole covers, valve boxes, and the like.
- B. Carefully apply the straightedge immediately after the first compaction by rolling, and from then on as may be necessary until and after the final compaction of the material in place. Hold the straightedge in successive positions parallel to the road centerline and in contact with the road surface; check the entire area from one side of the pavement to the other.
- C. Correct irregularities which vary $\frac{3}{8}$ inch from a true finished surface in base and binder courses, and $\frac{1}{4}$ inch in top courses.
- D. Irregularities which may develop before the completion of rolling and while the material is still workable, may be remedied by loosening the surface mixture and removing or adding material as necessary. Should any unsatisfactory irregularities or defects remain after final compaction, correct the defective work by removing and replacing with new material to form a true and even surface.

3.9 OPENING TO TRAFFIC

- A. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained, and the material has cooled sufficiently to prevent distortion or loss of fines, and the pavement has achieved a maximum temperature of 140 degrees F.
- B. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Engineer.

END OF SECTION

SECTION 025240

CURBS, GUTTERS AND WALKS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the construction of curbs, gutters, and walks.
1. Furnishing and installing granite curb, granite edging, curb inlets, and curb corners, precast concrete curb, cast-in-place concrete curb, and bituminous concrete curb and berms.
 2. All associated items and operations required to complete the installations, including surface preparation, concrete support, jointing, and finishing.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 02300 – EARTHWORK
 2. Section 03300 – CAST-IN-PLACE CONCRETE; for concrete, reinforcement, and incidentals pertaining thereto.
 3. Section 02513 – BITUMINOUS CONCRETE PAVEMENT; for asphalt mixes pertaining to bituminous curb.

1.2 QUALITY ASSURANCE

- A. Tolerances. Construct concrete surfaces within 1/4 inch of the indicated elevation, and deviating not more than 1/8 inch from a ten-foot straightedge placed anywhere on the surface.
- B. Provide strict compliance with requirements for air entrainment and curing.
- C. Delivery, storage and handling
1. Granite and precast curb units shall be adequately protected from damage during transit to the site.
 2. Curbing shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.
- D. Submittals:
1. Submit shop drawings and manufacturer's literature for granite and precast curb, edging, corners and inlets indicating size, shape and dimensions, finish, and setting method for Engineer's approval.
 2. Submit copies of tests on representative samples of the concrete used in the manufacture of precast units showing a compressive strength of 5,000 psi to the Engineer prior to shipping any units.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: Section 03300 - CAST-IN-PLACE CONCRETE, 4,000 psi.
- B. Prefomed Joint Filler: AASHTO M153.
- C. Hot-Poured Joint Sealer: AASHTO M173.
- D. Gravel Borrow: Section 02300 - EARTHWORK.
- E. Granite Curb:

- 1. Granite curb shall be light gray in color, free from seams and other structural imperfections or flaws which would impair its structural integrity, and of a smooth splitting appearance. Natural color variation characteristic of the deposit from which the curb is obtained will be permitted.
- 2. Whenever curbing is sawed, all surfaces that are to be exposed shall be thoroughly cleaned and any iron rust or iron particles removed by sandblasting or other methods approved by the Engineer and any saw mark in excess of 1/8 inch shall be removed.
- 3. Dimensions:

- a. The stones for the several types of granite curb shall be cut to the dimensions and curvature hereinafter needed:

| Type | Minimum Length | Width at Top | Depth | Minimum Width at Bottom |
|------|----------------|--------------|-----------------|---------------------------|
| VA-4 | 6 feet | 6 inches | 17 to 19 inches | 4 inches (for 2/3 length) |

- b. Stones to be set on a radius of 100 feet or less shall be cut to the required curvature, unless otherwise approved and, except for making closures, shall be of the following minimum lengths:

| Radius | Minimum Length |
|------------------------------|-----------------|
| 50 feet to 100 feet | 6 feet |
| 25 feet to less than 50 feet | 4 feet-6 inches |
| 10 feet to less than 25 feet | 3 feet |

4. Finish:

- a. Granite curb shall have a top surface free from wind, and shall be peen hammered or sawed to an approximately true plane, and shall have no projections or depressions greater than 1/8 inch. The front and back arris lines shall be pitched straight and true and there shall be no projection on the back surface for 3 inches down from the top which would exceed a batter of 4 inches to 1 foot.
 - 1) The front face shall be at right angles to the planes of the top and ends of the curb unit and shall be smooth quarry split, free from drill holes and with no projection

of more than 1 inch and no depression of more than 1/2 inch measured from the vertical plane of the face through the arris or pitch line for a distance down from the top of 8 inches. For the remaining distance, there shall be no projection or depression greater than 1 inch measured in the same manner.

- 2) The ends of all stones shall be square with the planes of the top and face of the curb so that when the stones are placed end to end as closely as possible, no space shall show in the joint at the top and face of more than 1/2 inch for the full width of the top and for 8 inches down on the face; after which the end may break back not over 8 inches from the plane of the joint. The arris formed by the intersection of the plane of the joint with the planes of the top and exposed faces shall have no variation from the plane of the top and exposed faces greater than 1/8 inch.

F. Granite Edging:

1. Granite shall conform to ASTM C615. Stone shall be hard and durable granite of a uniformly light grayish white color free from seams that would impair the structural integrity.
2. The stones for the granite edging shall be cut to the following dimensions:

| Top Width | Nominal Depth | Minimum Length |
|-----------|---------------|----------------|
| 4 inches | 12 inches | 3 feet |

3. The exposed face shall be smooth quarry split to an approximate true plane and still have no projections of more than 1-1/2 inches and no depression greater than 1 inch. The top shall be sawed and shall have no projection or depression greater than 1/4 inch. Any projection not meeting the above shall be dressed off.
4. The top and bottom lines of the face shall be pitched off to a straight line and shall not show over 1 inch between stone and straight edge when a straightedge is placed along the top and bottom lines.
5. The ends shall be square to the plane of the face so when placed end to end no space more than 1-1/2 inches shall show except on a radius of 10 feet or less where the finish joint shall be no more than 3/4 inch.
6. Drill holes not more than 3-1/2 inches or 1/2 inch in depth shall be permitted.
7. The sides shall not be under the square more than 4 inches or over the square at the back more than 1 inch.
8. The arris formed by the intersection of the plane of the face with the plane of the end joint shall not vary from the plane of the face more than 1/4 inch.

G. Bituminous Concrete Curbing: Shall conform to the requirements for Dense Mix as specified in Section 02513.

H. Cement Mortar: Cement mortar shall be composed of one part Portland cement and two parts of sand by volume with sufficient water to form a workable mix, Cement shall be Portland cement ASTM C150, Type II,

- I. Transition Sections: Horizontal transition sections shall be provided at all locations where curb sections change (i.e., vertical to sloped). Vertical transition sections shall also be provided for precast curb sections at wheelchair ramps. Vertical transition sections for granite curb shall be made as shown on the Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Excavate for and prepare the subgrade as specified in Section 02300 - EARTHWORK, true to the indicated grade and cross section.
- B. Place and compact a foundation of gravel borrow to the indicated thickness upon the prepared subgrade.
- C. Test completed gravel foundation with a template supported on the side forms, prior to concreting.

3.2 INSTALLATION

A. Granite Curb and Edging Installation

1. Excavation shall extend six (6) inches below and behind curb, as shown on the Drawings.
 - a. The gravel base shall be placed in the excavated area, graded and compacted to above the proposed curb subgrade.
2. Curbing and curb corners shall be set on additional gravel spread upon the foundation. All spaces under the curb and curb corners shall be filled with gravel thoroughly compacted so that the curb and curb corners will be completely supported throughout their length. The curb shall be set at the line and grade required as shown on the plans unless otherwise directed.
3. Edging shall be set on a thoroughly compacted base so that the edging will be completely supported throughout their length. Concrete shall be placed to support the edging base as shown on the plans.
4. Curb, curb corners or edging shall be fitted together as closely as possible
5. Immediately after the curb, curb corners, curb inlets, and edging is set, the space between it and the wall of the trench shall be filled with gravel thoroughly tamped to a depth of 6 inches, care being taken not to affect the line or grade of the curb, curb corners, curb inlets and edging. The trench shall continue to be filled with gravel and compacted in 6-inch lifts until grade is achieved.
6. If the curb materials and trench are part of reconstruction work and existing bituminous concrete surface is to remain, then the use of concrete backfill is acceptable, to an elevation suitable to support the pavement patch or section.

7. The joints between curbstones (both front and back) or edging shall be carefully filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones or edging shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints.
8. Transitions from normal curb settings to wheelchair ramps shall be accomplished with transition curb as shown on the drawings. Transitions shall be of the same type curb and similar to that abutting the transition piece and, if on a curve, of the same radius.
9. The ends of the stone curb at driveways and intersections shall be cut at a bevel or rounded, as shown on the Drawings.
10. If curb, curb corners, curb inlets, or edging of different quarries is used on the same project, curbing of each particular quarry shall be segregated and set to give uniform appearance.
11. Procedures for removal and resetting of existing granite curb, and new granite curb, in existing pavements shall include the following:
 - a. Prior to excavation for existing granite curb removal, the pavement surface shall be saw cut a minimum of one foot from the face of curb.
 - b. Existing curb shall be carefully excavated, and removed in a manner that protects the curb and existing pavement to remain from damage.
 - c. Existing granite curb shall be cleaned by sandblasting as required to remove bituminous material, paint and concrete from exposed surfaces prior to resetting in the proposed work.
 - d. New granite curb shall be set to match the top of existing granite curb remaining in place at abutting sections and, if required, transitioned to the typical section shown on Drawings within the first section of curb. Cement concrete shall be placed along the front face of the curb as shown on the Drawings.

B. Precast Concrete Curb

1. Precast units delivered to the site shall be inspected for damage, unloaded and placed along the prepared curb trench, or other designated location, with the minimum amount of handling.
 - a. Materials shall be handled in a manner that prevents damage to the curb units.
 - b. All individual pieces of curved curbing shall be marked to correspond to the radius and location where curbing is to be set.
2. Excavation shall extend 6 inches below and behind finished curb, as shown on the Drawings.
 - a. The gravel base shall be placed in the excavated area, compacted and graded to the proposed curb subgrade.
3. Precast concrete curb units shall be doweled together continuously to the line and grade shown on the Drawings. Any units damaged during setting operations shall be removed and replaced.

4. After the curb is set, the trench shall be backfilled immediately with approved material. The first layer shall be 4 inches in depth and compacted. The other layers shall be not more than 6 inches in depth and compacted until the trench is filled. Care shall be taken to prevent disturbing the line or grade of the curb during this procedure.

C. Bituminous Concrete Curb and Berm

1. General Requirements

- a. Bituminous curb shall be constructed by the use of an approved self-propelled extruding curb machine equipped with a material hopper, distributing screw and curb forming device capable of placing the bituminous mixture to the required lines, grades and proper curb cross-section. Prior to the placement of any curb, the Contractor shall submit a detail of the cross-section of the curb mold to the Engineer for approval.

2. Surface Preparation

- a. Before curbing is to be placed on pavement, the pavement surface shall be thoroughly swept and cleaned by mechanical sweepers and allowed to dry. If the curb is to be placed on cement concrete pavement, the concrete shall receive a coating of tack coat material prior to placement of the curb.

3. Placing and Compaction

- a. The hot bituminous mixture shall be placed in the hopper of the curb paver without segregation and extruded through the mold form to provide the proper compaction and surface texture.
- b. The curb paver shall be properly supported and weighted during operation along the edge of the pavement and shall be guided along string or chalk lines to maintain the proper alignment and level of the completed curb.
- c. Any portions of the completed curb, which are not satisfactorily compacted, show signs of sagging, cracking, and distortion, do not conform to the required lines, grades or cross section, and which cannot be satisfactorily repaired, shall be removed and replaced at no additional cost to the Owner.

4. Joints: Bituminous curb construction shall be a continuous operation in one direction only without joints. When placing of the curb is discontinued for a length of time that permits the mixture to cool, the curb shall be cut in a true vertical plane and the exposed end painted with tack coat material just prior to placing the fresh curb mixture against the previously constructed curb to achieve a continuous bond.

5. Curing: The newly completed curb shall be protected from traffic or other disturbance by barricades or other suitable methods until adequate stability has been obtained, but in no case less than twelve hours.

D. Bituminous Concrete Curb and Berm

1. General: Concrete curb shall be cast in place to the size, shape, line and grade shown on the Drawings. The curbing shall be constructed using clean, undamaged forms and in segments separated by construction joints and expansion joints.
2. Preparation: The curb trench shall be excavated, and the gravel base placed to the dimensions shown on the Drawings. The gravel base shall be compacted and graded to the proposed curb subgrade.
3. Forms: Forms shall be metal or acceptable planed and matched lumber, straight and free from warp or other irregularities that will adversely affect the installation. Forms shall conform to the curb cross-sections shown on the drawings and shall be carefully set to line and grade, thoroughly braced and secured in place so that there will be no displacement during placing of the concrete. All forms shall be thoroughly cleaned prior to reuse.
4. Placing of Concrete: Prior to placing the concrete, the subgrade shall be moistened, and the contact surfaces of the forms given a light coating of oil that will not discolor the concrete. Concrete shall be placed in the form, struck off with a template and spaded or otherwise compacted to eliminate voids and finished to a smooth even surface. The concrete may be compacted by mechanical vibrators if approved by the Engineer. Placing by slip form methods shall be approved by the Engineer.
5. Expansion Joints: Vertical expansion joints shall be located approximately every 75 linear feet and shall match the location of points of curb curvature and tangency and expansion joints in any adjacent concrete pavements and sidewalks. Expansion joints shall be constructed vertical, plumb, and at right angles to the face of the curb. Expansion joints shall be 1/2 inch in width and formed with premolded bituminous joint filler cut to conform to the curb cross-section.
6. Construction Joints: Vertical construction joints shall be located approximately every 15 feet equally spaced between expansion joints. The length of the curb segments may be varied slightly for closures, but in no case shall they be less than 8 feet. Construction joints shall be vertical, plumb and at right angles to the face of the curb and shall be formed by approved method that will provide complete separation of the curb segments during the placing of the concrete. If curb is formed by slip form methods, the joints shall be sawed as soon as practicable after the concrete has set to prevent raveling during the sawing and before any shrinkage cracking occurs in the concrete.
7. Finishing: Forms shall be left in place for 24 hours or until the concrete has sufficiently cured to permit removal without injury to the curb. Upon removal of the forms, the exposed faces of the curb shall be immediately rubbed to a uniform surface. Rubbing shall be performed by an experienced concrete finisher. Plastering with cement mortar to fill defects will not be permitted.

END OF SECTION

SECTION 025770

PAVEMENT MARKING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the furnishing and application of reflectorized pavement markings.
- B. All work shall be completed in accordance with the Maine Department of Transportation (MEDOT) Standard Specifications, dated March 2020 or later, Sections 627 and 700.

1.2 SUBMITTALS

- A. Submit a schedule of pavement marking operations to the Engineer, for approval, not less than seven days prior to the proposed date of application of any pavement marking.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pavement Marking Paint: Paint for final and temporary pavement markings shall meet the requirements of MEDOT Maintenance Fast-Dry Water-Based Traffic Paint on file at the Traffic Section in Augusta or at the following website: <https://www.maine.gov/mdot/contractors/publications/>
- B. Reflectorized Plastic Pavement Marking: See Section 712.05 of the MEDOT Standard Specifications for requirements.

PART 3 - EXECUTION

3.1 PREPRATION

- A. The Contractor shall cordon off areas where markings are being applied, but maintain access for vehicular and pedestrian traffic as required for other construction activities. Flagmen, barricades, drums, warning signs, warning lights, and similar devices shall be used as required.
- B. The Contractor shall clean the pavement of dust, dirt, old pavement markings, concrete curing compounds, and other foreign material which may be detrimental to the adhesion of the pavement marking materials.

3.2 REMOVAL OF EXISTING PAVEMENT MARKINGS

- A. Existing pavement markings that conflict with the proposed markings and those shown on the Drawings shall be removed.
 - 1. Pavement markings shall be removed before any change is made in the traffic patterns.
 - 2. Any excessive damage to the pavement caused by pavement marking removal shall be repaired by the Contractor by methods acceptable to the Engineer at no additional cost to the Owner.
- B. Approved methods of pavement markings removal include:
 - 1. Sandblasting using air or water
 - 2. High pressure water
 - 3. Steam or superheated water
 - 4. Mechanical devices such as grinders, sanders, scrapers, scarifiers and wire brushes
- C. Painting over a pavement marking line with asphaltic liquids or paints will not be allowed unless approved by the Engineer.
- D. Material deposited on the pavement from removal operations shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or could constitute a hazard to traffic will not be permitted.
- E. Where sandblasting is used for the removal of pavement markings and the removal operation is being performed within 10 feet of a lane occupied by traffic, the residue, including dust, shall be removed immediately as the marking removal progresses by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer.

3.3 APPLICATION OF MARKINGS

- A. Prior to applying paint for final pavement lines, the Contractor shall perform a test for paint thickness by furnishing and placing a piece of smooth, clean metal with an area of at least 144 in² in the path of the striping truck. The striping truck shall be passed over the piece of metal, painting the surface as it passes, without applying beads. The result of this test will be used to determine the pressure setting and speed of the truck when applying paint to obtain the specified thickness. Additional paint thickness testing may be required on the final paint markings. The wet thickness of paint without beads on final pavement lines shall be a minimum of 16 mils.
- B. On other final pavement markings and on curb, where the paint is applied by hand painting or spraying, application shall be in two uniform covering coats, each at least 10 mils thick. Before the second coat of paint has dried, the glass beads shall be applied by a pressure system that will force the glass beads onto the undried paint as uniformly as possible.
- C. Glass beads shall be applied to the final and temporary pavement lines, marking and curb at a sufficient rate and in sufficient quantity to assure complete and uniform coverage of hand painted surfaces and achieve proper reflectivity.

- D. Permanent and temporary white lines and markings shall have a minimum final reflectivity value of 250 millicandelas per square meter per lux (mcd/m²/lux) and permanent and temporary yellow lines and markings shall have a minimum final reflectivity value of 150 millicandelas per square meter per lux (mcd/m²/lux). Measurements taken to determine reflectivity shall be done within 4 weeks after final placement.
- E. If the final reflectivity values are less than the described minimums, the Contractor shall repaint those areas not meeting required reflectivity at no cost to the Client/Owner.
- F. Temporary painted lines and markings shall be applied as specified for permanent painted lines, except that the thickness shall be a minimum of 16 mils.
- G. Temporary pliant polymer marking material shall be used for temporary markings on the final pavement and on pavements not to be resurfaced when such pavement markings do not conform to the final pavement markings pattern.
- H. The plastic final pavement lines and markings shall be applied in accordance with the manufacturer's recommendations by the inlay method of application.
- I. Establishment:
 - 1. Inlaid plastic pavement lines and marking material furnished and installed under this contract for final pavement markings shall still be subject to a six-month period of establishment.
 - 2. The period of establishment shall commence as soon as the plastic pavement lines and markings are complete and in place and shall continue for six months. At the end of the establishment period, a minimum of 95% of the plastic pavement lines and markings shall still be in place to be acceptable.
 - 3. If less than 95% of the plastic pavement lines and markings are in place after six months, the Contractor shall replace all unsatisfactory plastic pavement lines and markings on the project without additional payment. Plastic pavement lines and markings designated for replacement shall be installed according to these specifications, unless otherwise directed. Plastic pavement lines and markings replaced at the end of the six month establishment period will not be subject to a further establishment period.

END OF SECTION

SECTION 026500

EXISTING SITE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the maintenance, support, protection, relocation, reconstruction and adjustment-to-grade, restoration, and abandonment of existing utilities affected by the construction work.
- B. For the purpose of this Section, utility means any public or private service, such as electric light and power systems; gas distribution systems; telephone, telegraph, cable television and other communication services; water distribution; storm drain and sanitary sewer services; police and fire communication systems; street lighting and traffic signs and signals; parking meters; and steam distribution systems.

1.2 GENERAL

- A. The location of existing underground pipes, cables, conduits, and structures as shown have been collected from the best available sources and the Authority together with its agents does not imply or guarantee the data and information in connection with the underground pipes, cables, conduits, structures and other parts as to their completeness nor their locations indicated. The Contractor shall contact utility owners and request marking location of all their lines in the work areas. The Contractor shall assume there are existing water, gas, electric and other utility connections to every building and structure, whether they appear on the Drawings or not. Any expense and/or damage to these shall be the responsibility of the Contractor.
- B. Foundations and lines for services, police and fire alarm boxes, street and pedestrian lights, and traffic signals may not be shown on the Drawings. The appropriate utility companies and/or agencies shall be contacted and consulted for locations of the above.
- C. All utility companies, public and private, shall be notified, including those in control of utilities not shown on the Drawings (prior to designing, excavating, blasting, installing, backfilling, grading, or restoring pavement. The Contractor shall Premark the area of excavation or work and notify the Dig Safe Center (1-888-DIG-SAFE) at least three business days prior to any excavation or work. In addition, notification shall be given to all affected private and/or public utilities to permit street marking of their lines.
- D. Some unknown utilities may exist in the areas to be excavated. The Contractor shall take the necessary precautions when excavated in areas of potential utility conflict. Precautions may include, but are not limited to soil vacuum excavation, hand digging, or other non-destructive means. The Contractor shall further be prepared to pre-excavate or pre-trench to locate potential utility conflicts prior to performing such activities as, but not limited to jacking, tunneling, installing temporary excavation support, etc.

- E. Interruptions of utilities shall not be permitted without written consent of the utility owner. The Contractor shall coordinate with all utilities and provide all temporary utilities and connections to avoid interruptions.

1.3 SUBMITTALS

- A. Submit working drawings and, if applicable, shop drawings showing the details, procedures, and scheduling for performance of the existing utility work. Show actual location of existing utility facilities; interferences which these facilities present to the new work; location of settlement markers; method proposed to proceed with the construction; details of proposed support systems; and, if applicable, method of testing and procedure for restoration.
- B. Submit written evidence of affected utility owners' approval of the details, procedure, and scheduling.
- C. Provide written notice two weeks in advance of the intended date to commence operations, to affected utility owners and parties having surface, subsurface or overhead structures in the construction area. Furnish the Engineer copies of all notices.
- D. If a settlement or movement monitoring system is required, submit copies of readings to the Engineer and affected utility owner within 24 hours of the reading.
- E. Submit to the Engineer, certifications from the respective suppliers that the products to be incorporated in the work are in conformance with applicable requirements.

1.4 NOTIFICATION

- A. Notify the appropriate utility agencies and the Engineer at least 48 hours prior to starting any work involving or adjacent to utility service facilities.
- B. Where an existing utility facility is encountered that is not indicated or that is determined to be a different utility facility than that indicated, promptly notify the Authority. The Contractor is responsible for determining the owner of the facility and the disposition of the facility.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Products and materials shall be as specified in the MaineDOT Standard Specifications or as shown on the Drawings, if applicable.

2.2 SALVAGE MATERIAL

- A. Reuse materials designated to be salvaged, provided they are inspected and approved by the respective utility owner and the Engineer. Salvaged material not designated for reuse or returned to the owner shall become the property of the Contractor.

- B. Maintain and have available for inspection by the Engineer a detailed record, including signed vouchers and receipts, of new and salvaged materials received from, used, or returned to the various utility owners.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conform to the specifications and standard practices of the affected utility owners. Coordinate with utility owners, which work shall be done by the Contractor and which work shall be done by utility owner at Contractor's expense. Ensure continuity of all existing utility services to all users except when the utility owner determines that temporary interruption is required.
- B. Unless otherwise indicated or authorized in writing by the Engineer, maintain all utility facilities complete in place.
- C. Abandoned Facilities
 1. Demolish and remove abandoned utility facilities in conflict with work.
 2. Do not undertake demolition or removal of the service until written approval for such work has been obtained from the utility owner.
 3. When abandoned facilities are indicated to be left in place, plug, or cap or bulkhead the ends of conduits and pipes, as indicated. Pipe or conduit greater than 15-in in diameter shall be completely filled with Controlled Density Fill. Remove abandoned utility manholes, junction boxes, and similar structures to a minimum depth of two feet below finish grade and fill the remaining void with sand or select fill, as specified in Section 02300 - EARTHWORK, after the plugging, or capping, or bulkheading of conduits and pipes has been completed. Puncture or break the bottom slabs of manholes and similar structures to provide drainage. Backfill and compact excavations resulting from removal of utility facilities, as required.
 4. Bulkheads for pipes greater than 15-in in diameter shall be constructed of solid concrete masonry bricks or solid concrete masonry blocks with full mortar joints. The bulkhead shall be watertight. Recess the bulkhead 1/2-in and seal with non-shrink grout.
- D. Provide, install, and maintain all temporary facilities required to provide interim utility service when a utility facility is to be relocated and when a utility facility to be replaced is abandoned prior to replacement.
- E. Where an existing utility facility is encountered which is not indicated, or which is determined to be a different utility service than that indicated, promptly notify the Engineer who will assist in determining the owner of the facility and the disposition of the facility.
- F. If, upon exposure, the condition or location of a facility to be supported complete-in-place is found by the Engineer to be unsafe for support or for maintenance of service, replace or reconstruct the facility as required, with prior approval of the Engineer and the utility owner.

3.2 SETTLEMENT OR MOVEMENT

- A. Provide suitable settlement or movement monitoring systems where indicated or required by the affected utility owner.
- B. In case of settlement or other movement which might cause damage, take immediate remedial measures to correct the conditions and damages caused by the settlement.

3.3 RECONSTRUCTION AND ADJUSTMENT-TO-GRADE

- A. Relay, reset, or otherwise reconstruct miscellaneous structures and facilities as indicated.
- B. Adjust-to-grade manholes and inlets as indicated, by raising or lowering the upper portion thereof.
- C. Backfill under utilities supported or exposed using controlled density fill to allow for the proper support and compaction under the utility. Contractor shall coordinate with the utility owner to determine the acceptability of the use of controlled density fill and shall work with the Owner to develop alternate means to ensure the proper backfill and compaction under the utility.

3.4 AS-BUILT UTILITY LOCATION AND CONDITION SURVEY

- A. For each new or relocated utility installed, including those installed or relocated by others in the Project Area, perform an as-built location survey by coordinates prior to backfilling the excavation.
- B. The survey data shall be obtained by Global Positioning Survey (GPS) and certified by a Professional Land Surveyor registered in Maine.
- C. A complete digital base plan shall be provided in a usable AutoCAD DWG format, properly referenced to the coordinate system established in the contract. The following standards shall be applicable:
 - 1. Text: Text shall be drawn using a STYLE of "L100-XX" (where XX refers to the plotted scale) and a font file of "SIMPLEX" as defined in the AutoCAD survey template provided by the Engineer. The style shall be defined as a "fixed height" style, and have a height of 0.10 times the drawing plotted scale. (i.e. 4.0 for 40 scale plan, 2.0 for 20 scale etc.).
 - 2. Precision and Accuracy:
 - a. Horizontal Survey:
 - 1) Precision: Horizontal control and surveyed points shall maintain a minimum precision of 1:10,000.
 - 2) Accuracy: No more than 10% of the survey points shall be in error by more than 1/100 inch or 0.25 mm when viewed at the requested scale.
 - b. Vertical Survey:
 - 1) Precision: Vertical Control shall have a maximum error of closure no greater than .075 feet or .02 meters.
 - 2) Accuracy: No more than 10% of elevations when interpolated from a Surface shall be in error of more than 1/2 a contour interval.

3. Surface Data: The data format shall conform to Autodesk Land Development Desktop Project files. If the Contractor uses a different software product to create a surface, then the surface must be represented as a TIN (Triangulated Irregular Network) of 3D lines on a separate, distinct layer within the AutoCAD drawing file. 3D faces or 2 dimensional lines are NOT acceptable.

END OF SECTION

SECTION 026510

FIBER OPTIC UTILITY COORDINATION

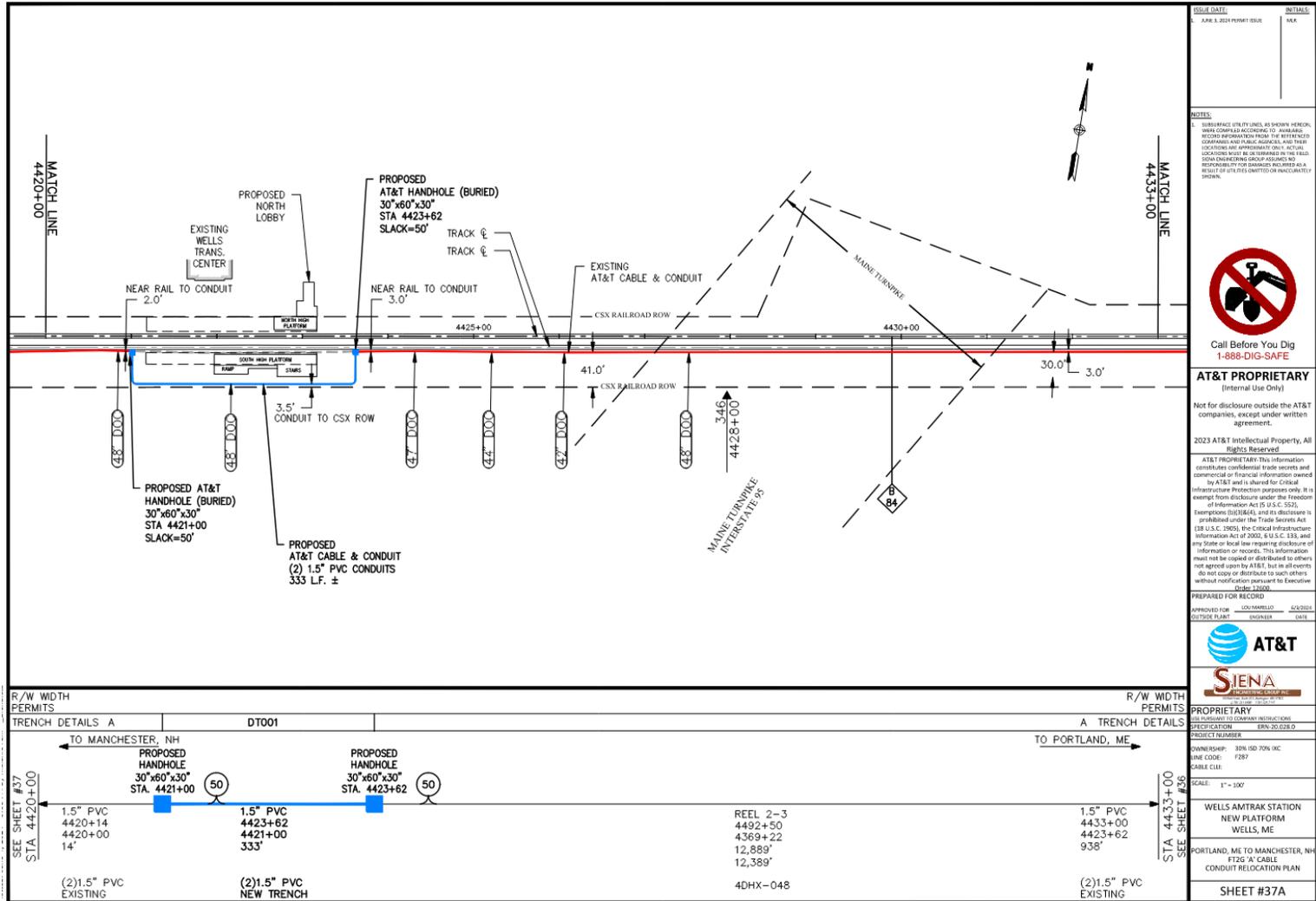
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section specifies the coordination of fiber optic utilities that are located within the Project.

1.2 GENERAL

- A. There are three existing fiber optic utilities located within the Project. There is one that generally runs parallel to the existing railroad tracks within the railroad right-of-way to the north owned by Cogent Communications, one that generally runs parallel to the railroad tracks within the railroad right-of-way to the south owned by AT&T, and one that is located within the Maine Turnpike Authority right-of-way providing service to the station building and existing north platform owned by Charter Communications. The general location of all fiber optic utilities are shown in the Plans.
- B. Contact information for each of the fiber optic utilities are below. Prior to construction, the Contractor shall coordinate with all 3 fiber optic utilities.
1. Siena Engineering Group, Inc. representing AT&T
Bob Jordan
(781) 221-8400 x7014
bob.jordan@sienaengineeringgroup.com
 2. Cogent Communications
Pat Conroy
(603) 493-5749
pconroy@cogentco.com
 3. Charter Communications
Peter Deteso
(207) 318-6542
peter.deteso@charter.com
- C. The existing AT&T and Cogent Communications fiber lines will remain. The Contractor shall coordinate with AT&T and Cogent Communications to protect and maintain their fiber optic lines in place. Minor impacts to the Charter Communications fiber optic line are shown in the Plans to construct the new platforms and install the communications lines for the Project.
- D. AT&T plans to construct a new spare utility conduit on the south side of the existing railroad tracks. The general location of the proposed spare utility conduit is shown on the attached plan sheet. After the Contractor has completed the Project's required clearing south of the railroad tracks, as shown in the Plans, the Contractor shall allow AT&T's Contractor to install the new spare utility conduit. The Contractor shall coordinate with AT&T to provide a schedule for when the new spare utility conduit can be installed and shall provide AT&T a minimum of 30 days' notice. AT&T anticipates that installation of the new spare utility conduit will take approximately 4 days.



| | |
|---------------------------|-----------|
| ISSUE DATE: | INITIALS: |
| APR. 3, 2024 PERMIT ISSUE | MLX |

NOTES:
 1. SUBSURFACE UTILITY LINES, AS SHOWN HEREON, ARE BASED ON RECORD DRAWINGS AND FIELD SURVEY DATA. LOCATIONS ARE APPROXIMATE ONLY. ACTUAL LOCATIONS MAY VARY. THE USER SHALL VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO ANY CONSTRUCTION. SIENA ENGINEERING GROUP ASSUMES NO RESPONSIBILITY FOR DAMAGE TO UTILITIES AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN.



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APPROVED FOR RECORD: [Signature]
 DATE: 4/2/2024
 OUTSIDE PLANT ENGINEER



PROPRIETARY
 IN ACCORDANCE TO COMPANY INSTRUCTIONS
 SPECIFICATION: ERN_20.028.0

PROJECT NUMBER: 30N ISD 70N IXC
 LINE CODE: 7287
 CABLE CL11
 SCALE: 1" = 100'

WELLS AMTRAK STATION
 NEW PLATFORM
 WELLS, ME
 PORTLAND, ME TO MANCHESTER, NH
 FTG 24 CABLE
 CONDUIT RELOCATION PLAN
SHEET #37A

| | | | | | |
|---------------------------------------|---|---|--|--|--|
| R/W WIDTH PERMITS | | DT001 | | R/W WIDTH PERMITS | |
| TRENCH DETAILS A | | | | A TRENCH DETAILS | |
| TO MANCHESTER, NH | | | | TO PORTLAND, ME | |
| SEE SHEET #37 STA 4420+00 | PROPOSED HANDHOLE 30"x60"x30" STA 4421+00 | PROPOSED HANDHOLE 30"x60"x30" STA 4423+62 | | | STA 4433+00 SEE SHEET #38 |
| 1.5" PVC 4420+14 4420+00 14' | 1.5" PVC 4423+50 4423+00 333' | 1.5" PVC 4423+50 4423+00 333' | | REEL 2-3 4492+50 4369+22 12,889' 12,389' | 1.5" PVC 4433+00 4423+62 938' |
| (2)1.5" PVC EXISTING | (2)1.5" PVC NEW TRENCH | (2)1.5" PVC NEW TRENCH | | 4DHX-048 | (2)1.5" PVC EXISTING |

END OF SECTION

SECTION 032540

ELASTOMERIC BEARING PADS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies elastomeric bearing pads for bridge structures.

1.2 SUBMITTALS

- A. Submit manufacturer's literature or shop drawings for products provided under this Section.
- B. Samples: Furnish one sample elastomeric bearing pad for each type of pad used in the work for destructive testing. Samples will be selected by the Resident at random from the lots delivered to the project site.

1.3 QUALITY ASSURANCE

- A. Test specimens will be cut from the sample elastomeric bearing pads and will be tested for conformance to these Specifications. For such test specimens a reduction of 10% in the minimum requirements for original tensile strength and ultimate elongation will be permitted.
- B. Hold Point - Do not set elastomeric bearing pads in place until the samples have been tested and approved by the Resident.

PART 2 - PRODUCTS

2.1 ELASTOMERIC BEARING PADS

- A. Type: Either plain bearing pads, consisting of elastomer only, or laminated bearing pads, consisting of layers of elastomer restrained at their interfaces by bonded laminates, as indicated. Railroad bridge bearing pads shall conform with Part 18 of the American Railroad Engineers Association (AREA) requirements.
- B. Elastomer portion of the elastomeric compound: 100% virgin chloroprene.
- C. Plain Type: Molded individually cut from previously molded strips or slabs, or extruded and cut to length: cut edges at least as smooth as ANSI 250 finish.
- D. Laminated Type: All components laminated bearing pads molded together into an integral unit and all edges of the non-elastic lamination covered by a minimum of 1/8 inch of elastomer -except at laminate restraining devices and around holes that will be entirely closed on the finished structure. Laminates: rolled mild steel sheets conforming to ASTM A 36, A 570, Grade C or D or A61 1, Grade C or D.

E. Physical Requirements

1. Finish, appearance, flash, and rubber to metal bonding, as defined in Rubber Manufacturers Association Handbook:
 - a. Thickness: no undersize and not more than 10% oversize.
 - b. Length and Width: As indicated, plus or minus 1/8 inch
 - c. Finish: commercial finish (Table V. Symbol F.3)
 - d. Flash: tear trim tolerance (Table VI. Symbol T.063)
 - e. Rubber-to-Metal Bonding (min.): 40 pounds per inch width (Grade 2. Method B. Table VIII).
2. Static load deflection: for any layer of elastomeric bearing, 7% maximum 800 psi average unit pressure when tested under laboratory conditions.
3. Physical Properties
 - a. Hardness, per ASTM D 2240: 60, plus or minus 6
 - b. Tensile strength, per ASTM D 412: 2500 psi minimum
 - c. Ultimate elongation, per ASTM D 412: 350% minimum
4. Heat Resistance per ASTM D 573, 70 hours at 212° F.
 - a. Change in durometer hardness: plus 15 points maximum
 - b. Change in tensile strength: minus 15% maximum
 - c. Change in ultimate elongation minus 40% maximum
5. Compression set, per ASTM D 395, Method B, 22 hours at 212°F: 35% maximum
6. Ozone cracking, per ASTM D1 149, 100-pphm ozone in air by volume, 20% strain, 100 plus or minus 2°F, 100 hours, mounting procedure A per ASTM D 518: no cracks.
7. Adhesion, per ASTM D429, Method B, bond made during vulcanization: 40 pounds per inch.
8. Low Temperature Test
 - a. Sample preparation: 96 hours at -20 plus or minus 2°F, axial load 500 psi strain of 20% effective rubber thickness.
 - b. Shear resistance after one hour at 25% shear strain: 75 psi maximum.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install elastomeric bearing pads in accordance with the details contained in the Contract Drawings. Make any adjustments required to install the bearing pads in the correct horizontal and vertical location.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items:
1. Cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures and finishes for the following applications:
 - a. Footings.
 - b. Foundation walls.
 - c. Slabs-on-grade.
 - d. Suspended slabs.
 - e. Concrete toppings.
 - f. Cutting and patching of mechanical and electrical penetrations through cast-in-place concrete.
- B. Related Requirements:
1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. Water Cement (W/C) Ratio: The ratio by weight of water to cementitious materials

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture, submit proposed mix proportions and test results confirming mix meets requirements stated below. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
1. Indicate amounts of mixing water to be withheld for later addition at Project site.
 2. Indicate amount of fly ash in the mix.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Indicate coordination requirements for reinforcement locations with requirements of structural steel, steel joints and steel deck.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
1. Location of construction joints not shown on the design drawings is subject to approval of the Resident.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Waterstops.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semirigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer licensed in the State of Maine, detailing fabrication, assembly, and support of formwork.
1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
 2. Blockouts for Architectural Joint Systems: Indicate blockouts and coordination with architectural joint systems.
- E. Floor surface flatness and levelness measurements to determine compliance with specified tolerances and requirements for applied finishes and materials, except as noted for slope to drains.
- F. Field quality-control test and inspection reports.
- G. Minutes of preinstallation meeting.

1.5 QUALITY CONTROL /QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment. Manufacturer shall be responsible for sampling and testing of concrete ingredients and establishing concrete mix proportions.
- B. **Independent Testing Agency Qualifications:** An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- C. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- D. **Preinstallation Conference:** Conduct conference at Project site to address the following:
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. **Steel Reinforcement:** Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. **Waterstops:** Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.7 FIELD CONDITIONS

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

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301 (ACI 301M).
 2. ACI 117 (ACI 117M).

2.2 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- B. Cementitious Materials:
1. Cement: Shall be American-made Portland Cement, free from water soluble salts or alkalis which will cause efflorescence on exposed surfaces. Portland Cement shall be Type II, ASTM C 150. Use only one brand of cement for each type of cement throughout project. Contractor shall be responsible for whatever steps are necessary to ensure that no visual variations in color will result in exposed concrete and shall place on order and secure in advance a sufficient quantity of this (these) cement(s) to complete concrete work specified herein.
 2. Fly Ash: ASTM C 618, Type F, 15-35%
 3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120, 25-50%
- C. Normal Weight Fine Aggregate: Shall be washed, inert, natural sand, free of materials with deleterious reactivity to alkali in cement, conforming to ASTM C 33 and following additional requirements:

1. Gradation in accordance with ASTM C33 Section 6
 2. Deleterious Substances: Limits for deleterious substances in fine aggregates shall comply with ASTM C 33, Table 2.
 3. Evaluate for potential alkali aggregate reactivity. Result of evaluation shall be submitted to the Resident for review.
- D. Normal Weight Coarse Aggregate: Shall be well graded crushed stone or washed gravel conforming to ASTM C 33 and the following additional requirements:
1. Gradation in accordance with ASTM C 33, Table 3 and represented by a smooth gradation curve within required limits.
 2. Limits for deleterious substances in coarse aggregates shall comply with ASTM C33, Table 4.
- E. Maximum designated sizes for normal weight coarse aggregate to be used in concrete sections shall be as noted below, except that sizes shall also be chosen in conjunction with required clearances.
1. One and one-half inches for sections over ten inches in thickness.
 2. One inch for sections more than eight and up to ten inches in thickness.
 3. Three-quarter inch for sections more than three and up to eight inches in thickness.
 4. One-half inch for section up to three inches in thickness.
- F. Concrete Fill for Steel Stair and Landing Pans: Composed of 1:2:2 mix with three-eighths inch maximum size normal weight aggregate and shall be placed with a 0 inches to 1 inch slump.
- G. Water: From approved source, potable, clean and free from oils, acids, alkali, organic matter and other deleterious material and complying with the requirements of ASTM C 94.
- H. Admixtures:
1. Water-reducing Admixture: ASTM C 494/C 494M, Type A.
 - a. "WRDA" - W.R. Grace & Co.
 - b. "PDA25" - Protex Industries, Inc.
 - c. "Pozzolith 344H" - Master Builder's Co.
 - d. Or approved equivalent
 - e. Note: Water-reducing agent shall be by same manufacturer as air-entraining agent.
 2. Air-entraining Admixture: ASTM C 260/C 260M.
 - a. "DAREX AEA" - W.R. Grace & Co.
 - b. "PROTEX AEA" - Protex Industries
 - c. "MB-VR" or "MB-AE" - Master Builder's Co.
 - d. Or approved equivalent
 3. Superplasticizer: High-range water-reducer conforming to ASTM C 494, Type F or Type G.
 4. Admixtures retarding setting of cement in concrete shall not be used without written approval of Resident.
 5. Admixtures causing accelerated setting of cement in concrete shall not be used without written approval of Resident.

2.3 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- C. Any deviation from approved mix design, which Contractor deems desirable under certain project conditions, will not be allowed without written approval of Resident. Cost of any additional testing by Testing Agency associated therewith shall be paid for by Contractor.

2.4 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Normal-weight concrete.
 - 1. Minimum Compressive Strength: 5000 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.40.
 - 3. Slump Limit: 4 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, +/- 1 inch.
 - 4. Air Content: 6 percent, +/- 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
- B. Foundation Walls: Normal-weight concrete.
 - 1. Minimum Compressive Strength: 5000 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.40.
 - 3. Slump Limit: 4 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 - 4. Air Content: 6 percent, +/- 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- C. Slabs-on-Grade: Normal-weight concrete.
 - 1. Minimum Compressive Strength: 5000 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.40.
 - 3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 - 4. Slump Limit: 4 inches, +/- 1 inch.
 - 5. Air Content: 6 percent, +/- 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- D. Topping Slab over Precast Panel and CLT Floor Panels: Normal-weight concrete.
 - 1. Minimum Compressive Strength: 5000 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.40.

3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
4. Slump Limit: 4 inches, +/- 1 inch.
5. Air Content: 6 percent, +/- 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

E. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Maximum W/C Ratio: 0.40.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- 6.

2.5 CONCRETE MIXING

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

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

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.6 FORM MATERIALS

A. Construct formwork to shapes, lines, and dimensions required, plumb and straight, secured and braced sufficiently rigid to prevent deformation under load, and sufficiently tight to prevent leakage, all in conformance with ACI Standard 347, "Recommended Practice for Concrete Formwork".

B. Formwork for exposed concrete shall be medium-density plastic overlaid plywood, 5/8" minimum thickness; for concealed concrete shall be "Plyform" plywood, 5/8" minimum thickness.

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

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

- E. Form Ties and Spreaders: Factory-fabricated, removable, or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units ties leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
- F. Form Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.7 STEEL REINFORCEMENT

- A. Reinforcing Steel Bars: Shall be newly rolled billet steel conforming to ASTM A 615 Grade 60. Bars shall be bent cold.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Welded Wire Fabric: Shall conform to ASTM A 185.
- D. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.8 REINFORCEMENT ACCESSORIES

- A. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.
- B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- C. Zinc Repair Material: ASTM A 780/A 780M.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.9 WATERSTOP

- A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

- B. 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. Williams Products, Inc.
 - 2. Profile: Ribbed with center bulb and Ribbed without center bulb.
 - 3. Dimensions: For walls, flat ribbed type, minimum 6 inches width by 3/8 inch thick at center with minimum 7 ribs each side of each flange. For slabs, ribbed center bulb type, minimum 9 inches wide by 3/8 inch thick next to bulb, minimum 9 ribs on each side of each flange, bulb minimum 1/2 inch ID and 7/8 inch OD; non tapered.

- C. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 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. BoMetals, Inc.
 - b. Sika Greenstreak.
 - 2. Profile: Ribbed with center bulb and Ribbed without center bulb
 - 3. Dimensions: For walls, ribbed without center bulb, minimum 6 inches width by 3/8 inch thick at center with minimum 7 ribs each side of each flange. For slabs, ribbed with center bulb type, minimum 9 inches wide by 3/8 inch thick next to bulb, minimum 9 ribs on each side of each flange, bulb minimum 1/2 inch ID and 7/8 inch OD; non tapered.

2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 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. BASF Corp. - Construction Chemicals.
 - b. Brickform; a division of Solomon Colors.
 - c. Dayton Superior.
 - d. Euclid Chemical Company (The); an RPM company.
 - e. Kaufman Products, Inc.
 - f. Nox-Crete Products Group.
 - g. Sika Corporation.
 - h. SpecChem, LLC.
 - i. TK Products.

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

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

- D. Water: Potable.

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corp. - Construction Chemicals.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. Kaufman Products, Inc.
 - e. Nox-Crete Products Group.
 - f. Right Pointe.
 - g. SpecChem, LLC.
 - h. TK Products.
 - i. Vexcon Chemicals Inc.
 - j. W.R. Meadows, Inc.

2.11 MISCELLANEOUS MATERIALS

- A. Grout: Ready-to-use aggregate product requiring only addition of water at job site such as "Embeco Pre-mixed Grout" by Master Builder's; "Vibro-Foil Ready-Mixed" by W.R. Grace & Co.; or "Ferrolith G" by Sonneborn Building Products, Inc. Grout shall be easily workable and shall have no drying shrinkage at any age. Compressive strength of grout (2" x 2" cubes) shall not be less than 5000 psi at 7 days, and 7500 psi at 28 days.
- B. Vapor Barrier: 6 mil polyethylene, unless specifically specified elsewhere.
- C. Chemical Hardener: All exposed concrete floor slabs shall be hardened with three applications of fluosilicate chemical hardener followed by two applications of clear acrylic concrete sealer by Sonneborn Division, ChemRex Inc. "Lapidolith"; or equal products by W.R. Meadows Co. and Concrete Service Material Company or other manufacturers.
- D. Penetrating Sealer: Monomeric alkyalkoxy silane sealer which has demonstrated penetrability into dry low permeability concrete to a minimum of 1/4 inch. Sealer shall have 20 to 25 percent solids when used on walls, and 40 to 50 percent solids when used on floors.
- E. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- F. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- G. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 1. Types I and II, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine all work prepared by others to receive work of this Section. Commencement of work will be construed as complete acceptance of preparatory work by others.
 - 1. Hold Point-A pre-placement inspection shall be performed by the Contractor prior to placing concrete to assure that placement prerequisites have been accomplished.

3.2 HANDLING, STORAGE, AND PROTECTION OF MATERIALS

- A. Handle and store materials separately in such manner as to prevent intrusion of foreign matter, segregation, or deterioration. Do not use foreign materials or those containing ice. Remove improper and rejected materials immediately from point of use. Cover materials, including steel reinforcement and accessories, during construction period. Stockpile concrete constituents properly to assure uniformity throughout project.

3.3 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.

- I. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 EMBEDDED ITEM INSTALLATION

- A. Conform to requirements of ACI 318, paragraph 6.3, "Conduits and Pipes Embedded in Concrete", and as specified below.
- B. Install steel sleeves, embedded wall plates and similar items, furnished by other trades, at locations shown on the drawings.
- C. Anchor bolts for column baseplates shall be installed with templates provided. Vertical alignment and plan locations shall be maintained within one-sixteenth inches of the locations shown on the drawings.
 - 1. Inspection shall be performed by a surveyor licensed in the State of Maine. Certify compliance with shop drawings.

3.5 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

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

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 STEEL REINFORCEMENT INSTALLATION

- A. Reinforcement shall be placed in accordance with requirements of CRSI 93, "Recommended Practice for Placing Reinforcing Bars" and CRSI 93, "Recommended Practice for Placing Bar Supports" and with further requirements below.
- B. Reinforcement shall be accurately placed in accordance with Contract Documents and shall be firmly secured in position by wire ties, chairs, spacers, and hangers, each of type approved by Resident.
- C. Bending, welding or cutting reinforcement in field in any manner other than as shown on Drawings, is prohibited, unless specific approval for each case is given by Engineer.
- D. Reinforcement shall be continuous through construction joints unless otherwise indicated on Drawings.
- E. Reinforcement shall be spliced only in accordance with requirements of Contract Documents or as otherwise specifically approved by Engineer. Splices of reinforcement at points of maximum stress shall generally be avoided. Welded wire fabric shall lap six inches or one space plus two inches whichever is larger, and shall be wired together.
- F. At time concrete is placed, reinforcement shall be free of excessive rust, scale, or other coatings that will destroy or reduce bond requirements. Reinforcement expected to be exposed to weather for a considerable length of time shall be painted with a heavy coat of cement grout. Protect stored materials so as not to bend or distort bars in any way. Bars that become damaged will be rejected.
- G. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- H. Hold Point - Before concrete is cast, check all reinforcement after it is placed to insure that reinforcement conforms to Contract Documents and approved Shop Drawings. The Resident shall be notified at least 36 hours prior to concrete placement and given opportunity to inspect completed reinforcement and formwork before concrete placement. Prior approval of Shop Drawings shall in no way limit Resident's right to demand modifications or additions to reinforcement or accessories.

3.8 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Resident.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action

does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 WATERSTOP INSTALLATION

- A. Protect waterstop from oil, dirt, concrete spatter, and damage, and leave clean to receive concrete forms. Exercise care during installation of waterstop to eliminate all possibilities that may cause leakage. Ensure reinforcing bars and slip dowels will not interfere with positioning of waterstop during Installation.
- B. Install waterstops in accordance with manufacturer's recommendations and as indicated. Hold waterstops rigidly in place by extending through slots in keyways, by spilt bulkheads, by tying to reinforcing bars, or by such other adequate methods as are necessary to insure proper support and embedment during the concreting process. Secure waterstop between the last rib and the end of the waterstop when tying to reinforcing rods. Tie waterstop to reinforcing bars every 12 inches.
- C. Install waterstop so that half of the ribs of the waterstop material are embedded in the concrete on each side of the joint. When installed in an expansion joint, exercise care in pouring so that the closed hollow center-bulb remains in the gap between the first and second pour, to allow for maximum elongation with minimum stress on the portion of the waterstop embedded in the concrete.
- D. Install expansion joint material and a sealant in the joint, as indicated, to prevent foreign matter from accumulating in the joint area. When a sealant is used place a separator between the sealant and the waterstop to ensure that both the waterstop and sealant best perform their respective functions.
- E. Sweep horizontal joints prior to pour to insure that foreign matter does not interfere with direct contact between the waterstop and concrete.
- F. Systematically and thoroughly vibrate concrete around waterstop to avoid honeycombs and voids in the concrete and to insure complete contact of waterstop to concrete.
- G. For the second pour on horizontal sections, make a grout pour over the waterstop to prevent excessive movement of the waterstop and to provide positive insurance against honeycombing or voids. Use a thicker waterstop. 3/8 inch or 1/2 inch. for heavy pour or larger aggregate.
- H. Where using split-ribbed waterstop spread open the split leg of the waterstop and nail it to the bulkhead between the last two ribs. Upon completion of the first pour and removal of the bulkhead, join the split leg together every 12 inches with hog rings and position it for the second pour.

- I. PVC waterstop may be butt-spliced on the job with an electrical splicing iron or a hot air welding gun and vinyl welding rod in accordance with the manufacturer's instructions.
- J. Do not drive nails through center of waterstop. Do not lap waterstop, splice joints. Do not embed center bulb in concrete. Position it in the center of the joint to insure freedom of movement. Do not secure waterstop except between the last rib and the end of the waterstop when tying to the reinforcing rod to hold in place for the pour. Where using split-ribbed waterstop, do not nail split legs to bulkhead adjacent to bulb.

3.10 MIXING, CONSISTENCY, AND DELIVERY OF CONCRETE

- A. Concrete shall be ready-mixed, produced by plant acceptable to Resident. Constituents, including admixtures except certain corrosion inhibitors and superplasticizers, shall be batched at central batch plant. Admixtures shall be premixed in solution form and dispensed as recommended by manufacturer.
- B. Central plant and rolling stock equipment and methods shall conform with Truck Mixer and Agitator Standard of Truck Mixer Manufacturer's Bureau of National Ready-Mixed Concrete Association, and Contract Documents. Consistency of concrete at time of deposit shall be as per section 2.2F.
- C. Ready mixed concrete shall be transported to site in watertight agitator or mixer trucks loaded not in excess of rated capacities. Discharge at site shall be within one and one-half hours after cement was first introduced into mix. Discard concrete not discharged within one and one-half hours and dispose of legally. Concrete with a temperature greater than 85 degrees F. shall not be placed. Central mixed concrete shall be plant mixed a minimum of five minutes. Agitation shall begin immediately after premixed concrete is placed in truck and shall continue without interruption until discharged. Transit mixed concrete shall be mixed at mixing speed for at least ten minutes immediately after charging truck followed by agitation without interruption until discharged. Concrete shall be furnished by a single plant unless accepted by the Resident in writing.
- D. Retempering of concrete which has partially hardened, that is, mixing with or without additional cement, aggregates, or water, will not be permitted.

3.11 PLACING CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Remove water and foreign matter from forms and excavations and, except in freezing weather or as otherwise directed, thoroughly wet wood forms just prior to placing concrete. Place no concrete on frozen soil and provide adequate protection against frost action during freezing weather.
- C. To secure full bond at construction joints, surfaces of concrete already placed, including vertical and inclined surfaces, shall be thoroughly cleaned of foreign materials and laitance, roughened with suitable tools such as chipping hammers or wire brushes, and recleaned by stream of water or compressed air. Well before new concrete is deposited, joints shall be saturated with water. After free or glistening water disappears joints shall be given thorough coating of neat cement slurry mixed to consistency of very heavy paste. Surface shall receive coating of approximately one-eighth inch thick; this shall be scrubbed in by means of stiff bristle brushes. New concrete shall be deposited before neat cement dries or changes color.
- D. Do not place concrete having slump outside of allowable slump range.

- E. Transport concrete from mixer to place of final deposit as rapidly as practical by methods which prevent separation of ingredients and displacement of reinforcement, and which avoid rehandling. Deposit no partially hardened concrete. When concrete is conveyed by chutes, equipment shall be of such size and U-shaped design as to insure continuous flow in chute. Flat (coal) chutes shall not be employed. Chutes shall be of metal or metal lines and different portions shall have approximately same slope. Slope shall not be less than 25 degrees nor more than 45 degrees from horizontal and shall be such as to prevent segregation of ingredients. Discharge end of chute shall be provided with baffle plate or spout to prevent segregation. If discharge end of chute is more than five feet above surface of concrete in forms, spout shall be used, and lower and maintained as near surface of deposit as practicable. When operation is intermittent, chute shall discharge into hopper. Chute shall be thoroughly cleaned before and after each run and debris and any water used shall be discharged outside forms. Concrete shall not be allowed to flow horizontally over distances exceeding five feet.
- F. Concrete shall be placed in such manner as to prevent segregation, and accumulations of hardened concrete on forms or reinforcement above mass of concrete being placed. To achieve this end, suitable hoppers, spouts with restricted outlets and tremies shall be used as required.
- G. During and immediately after depositing, concrete shall be thoroughly compacted by means of internal type mechanical vibrators or other tools, or by spading to produce required quality of finish. Vibration shall be done by experienced operators under close supervision and shall be carried on only enough to produce homogeneity and optimum consolidation without permitting segregation of constituents or "pumping" of air. Vibrators used for normal weight concrete shall operate at speed at not less than 7,000 vpm and be of suitable capacity. Do not use vibrators to move concrete. Vibration shall be supplemented by proper wooden spade puddling to remove included bubbles and honeycomb adjacent to visible surfaces. At least one vibrator shall be on hand for every 10 cubic yards of concrete placed per hour, plus one spare. Vibrators shall be operable and on site prior to starting placement.
- H. Vertical lifts shall not exceed 18 inches. Vibrate completely through successive lifts to avoid pour lines. Vibrate first lift thoroughly until top of lift glistens to avoid stone pockets, honeycomb, and segregation.
- I. Concrete shall be deposited continuously, and in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within section. If section cannot be placed continuously between planned construction joints, as specified, field joint and additional reinforcement shall be introduced so as to preserve structural continuity. Resident shall be notified in any such case.
- J. Cold joints, particularly in exposed concrete, including "honeycomb", are unacceptable. If they occur in concrete surfaces exposed to view, Resident will require that entire section in which blemish occurs be removed and replaced with new materials at Contractor's expense.
- K. When placing exposed concrete walls or columns, strike corners of forms rapidly and repeatedly from outside along full height while depositing concrete and vibrating.
- L. Chutes, hoppers, spouts, adjacent work, etc. shall be thoroughly cleaned before and after each run and water and debris shall be discharged outside form.

3.12 FINISHING FORMED SURFACES

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

1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated. Rough struck surface shall be provided at top of pedestals.

3.13 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces to be covered with roofing rigid insulation and membrane
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 3. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- D. Contractor, at his own expense, shall level depressed spots and grind high spots in concrete surfaces which are in excess of specified tolerances. Leveling materials proposed for providing proper surface shall be approved by Resident.

3.14 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 8 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place, and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.15 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. **Moisture-Retaining-Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. **Curing and Sealing Compound:** Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.16 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.17 CONCRETE SURFACE REPAIR

- A. **Defective Concrete:** Repair and patch defective areas when approved by Resident. Remove and replace concrete that cannot be repaired and patched to Resident's approval at no additional cost to owner.
- B. **Patching Mortar:** Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. **Repairing Formed Surfaces:** Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area

- at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Resident's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.18 REMOVAL OF FORMWORK, SHORING AND RESHORING

- A. Contractor shall be responsible for proper removal of formwork, shoring, and reshoring.
- B. Forms shall be removed only after concrete has attained sufficient strength to support its own weight, construction loads to be placed thereon and lateral loads, without damage to structure or excessive deflection.
- C. Forms and falsework shall not be removed unless the concrete has attained the minimum percentage compressive strength as listed in the following table:

| Structural Member | Minimum Percent of Design Strength (f'c) |
|--|--|
| Invert Slabs; Slabs and Beams on Grade | 25 |

| | |
|---|----|
| Free Standing Walls, Columns and Piers | 40 |
| Retaining Walls | 50 |
| Soffits of Beams, Slabs and Girders Less Than 20 Foot Span | 80 |
| Stairs | 80 |
| Soffits of Beams, Slabs and Girders Greater Than 20 Foot Span | 90 |
| Cantilevered Beams, Slabs and Girders | 90 |

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.

- a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Resident, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Resident but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.20 CLEANING

- A. Concrete surfaces shall be cleaned of objectionable stains as determined by the Resident. Materials containing acid in any form or methods which will damage "skin" of concrete surfaces shall not be employed, except where otherwise specified.

END OF SECTION

SECTION 033300

ARCHITECTURAL CONCRETE

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. Cast-in-place architectural concrete including form facings, reinforcement accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
 - 2. The requirements of this Section complement Section 033000, CAST-IN-PLACE CONCRETE; and apply to architectural concrete as specified and as indicated on Drawings.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for formwork; material, fabrication, and installation requirements for steel reinforcement; and field quality control.
 - 2. Section 079200 - JOINT SEALANTS for elastomeric joint sealants in contraction and other joints in cast-in-place architectural concrete.

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 SUBMITTALS

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

- B. Description of Methods and Sequence of Placement. For each type of specially-finished concrete provide description of methods and sequence of placement.
- C. Certificates: Prior to installation submit copies of a signed affidavit from the manufacturer of the coloring product stating that coloring product to be used in concrete is compatible with the concrete mix and type to which it will be combined, and that no adverse affects will occur to the workability, setting, or strength of concrete.
- D. Manufacturer's Review: Submit written signed statement, that Contract Documents have been reviewed by qualified representatives of the materials manufacturer, and that materials and system to be used for floor finish are proper and adequate for the applications shown.
- E. Manufacturer's Data: Submit manufacturer's specifications and installation instructions for all products in concrete floor finish, including certifications and other data as may be required to show compliance with the Contract Documents.
- F. Substrate Acceptability: Submit a certified statement issued by the manufacturer of concrete floor finish materials and countersigned by installer, attesting that surfaces designated to receive concrete floor finish are satisfactory warranty requirements. Application of materials will be construed as acceptance of surfaces.
- G. Statement of Supervision: Submit signed statement signed that field supervision by manufacturer's representative was sufficient to ensure proper application of materials and that the installation is acceptable to manufacturer.
- H. Samples for Verification: Architectural concrete samples, cast vertically, approximately 18 by 18 by 2 inches, of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.5 QUALITY ASSURANCE

- A. Finish Objective Samples. If samples are placed on display in the office of the Architect, to describe finish objectives, such samples are hereby made part of these Specifications to the degree that the samples exhibit the required color, texture and surface finish requirements. Such samples, if provided, are provided for bidding purposes only; the actual mix components, forming, placing, and finishing procedures and requirements shall be as determined by acceptable preconstruction mock-ups.
- B. Preconstruction Conference. Attend a preconstruction conference prior to the start of architectural concrete construction as directed by the Architect. Discussion will include the following:
 - 1. The Contractor's program to obtain the specified quality of architectural concrete.
 - 2. The procedures and methods for construction of preconstruction mock-ups specified herein.
- C. Preconstruction Mock-up Panels or Areas:
 - 1. General:

- a. Schedule mock-up casting for acceptance 30 days prior to casting of architectural concrete surfaces represented by the mock-ups.
 - b. Locate mock-up panels in non-public areas acceptable to the Architect. Brace panels as required for safety.
 - c. Continue to cast mock-ups until acceptable mock-ups are produced. Accepted mock-ups shall be the standard for color, texture, and workmanship for the work.
 - d. Mock-up sequence of forming, placing, form removal, curing and finishing shall be reviewed and accepted by the Architect.
 - e. Mock-up formwork shall be inspected and accepted by the Architect before placing of concrete.
 - f. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Architect.
 - g. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
 - h. Remove mock-up panels from site at completion of Project, as directed by the Architect.
2. Construct mock-up panels or areas as indicated to demonstrate the ability to cast architectural concrete to achieve shapes, color, and textured finishes required. Mock-ups shall include or meet the following requirements:
- a. Provide full scale mock-up panels and areas.
 - b. Provide mock-ups simulating actual design and execution conditions for concrete mix materials, reinforcement, formwork, placing sequence, form removal, curing, finishing, and methods and materials of stain removal and correction of defective work.
 - c. On mock-ups where directed by the Architect, provide minimum of five variation of mix color to be used in the repair of defective work, in order to determine acceptable color and texture match.
 - d. Demonstrate, on the mock-ups, materials and methods of plugging tie-holes unless tie holes are indicated to be left in place.
 - e. Demonstrate in the construction of the mock-up formwork the sealer material, form release agent, and curing materials and methods to be used.

- D. Source of Materials. Utilize the same source, stock or brand of concrete materials for each class or mix of architectural concrete. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish, texture, and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened containers identified with brand, type, grade, date of manufacture, class, lot number, and other qualifying information.
- B. Store materials in original sealed containers, in dry enclosed storage area, within temperature range recommended by manufacturer.

1.7 JOB CONDITIONS

- A. Maintain manufacturer's current installation instructions at Project site.

- B. Maintain interior building area above 50oF before, during, and after installation of architectural concrete until structure and subfloor temperatures are stabilized.
- C. Provide and maintain adequate ventilation until concrete cures completely.

1.8 PROTECTION

- A. Protect adjacent surfaces and repair, restore, or replace soiled or damaged in performance of special architectural concrete finish work.

1.9 GUARANTEE

- A. Warrant work of this Section for five years from date of Substantial Completion; correct defects upon written notice at no additional cost to Owner. Warranty shall be signed by installer and materials manufacturer.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Except as otherwise indicated, concrete materials including aggregates, Portland cement, and water shall conform to Section 033000, CAST-IN-PLACE CONCRETE.

2.2 ARCHITECTURAL CONCRETE FOR VERTICAL WALLS

- A. Concrete: Color of concrete shall be normalweight concrete without color additive; color for architectural concrete shall be uniform throughout area designated.
- B. Formwork Ties: Formwork tie spacing and location of ties shall be in a consistent pattern or layout acceptable to the Architect. Tie design shall be acceptable to the Architect.
- C. Formwork Materials: Steel faced or fiberglass faced formwork as required to produce a smooth form finish acceptable to the Architect.

1. Formwork for Board Formed Concrete:

- a. Basis of Design: Sika; Architectural Concrete Formliners.
- b. Pattern as selected by Architect.

2. Architectural Concrete Finish No. 1 - Smooth Form Finish with Smooth Rubbed Finish:

- a. Formwork: Smooth form concrete using steel forms or fiberglass forms. Joints in formwork shall be sealed. Form ties shall be uniformly placed accurately located in accordance with layout approved by the Architect.
- b. Finish Description/Procedure: Rubbing shall be produced on newly hardened concrete no later than the day following form removal. When required by the Architect to correct work done in an incorrect manner or in a manner not as specified, rubbing shall commence within 48 hours of notification by the Architect. Surfaces to be rubbed shall be wetted and rubbed with carborundum brick or other approved abrasive of equal quality until uniform color and texture are produced, without applying any cement, grout or other coating. Rubbing will not be

permitted when the air temperature is expected to fall below 40 degrees F. Rubbing may be performed by use of approved power equipment and tools, providing that the operational procedures shall produce the same desired effects as hand rubbing.

- c. Cement Color: Color meeting approved mock-up. In order to achieve the desired color/finish of concrete, concrete mix may required the use of a white cement or control of color of aggregates may be required.

PART 3 - EXECUTION

3.1 PLACING CONCRETE

- A. Except as modified herein, concrete shall be placed in accordance with Section 033000, CAST-IN-PLACE CONCRETE.
 - 1. Consolidate vertical colored concrete in lifts 1 ft. or less in depth and vibrate twice that normally required by decreasing the spacing, depth, and time to ensure uniform color.
 - 2. There shall be no honeycombing or segregated aggregates in concrete exposed to view in areas identified as Architectural Concrete.
- B. Finish: Provide the following finish for vertical Architectural Concrete:
 - 1. Smooth form finish with smooth rubbed finish. Rubbing shall be produced on newly hardened concrete no later than the day following form removal. When required by the Architect to correct work done in an incorrect manner or in a manner not as specified, rubbing shall commence within 48 hours of notification by the Architect. Surfaces to be rubbed shall be wetted and rubbed with carborundum brick or other approved abrasive of equal quality until uniform color and texture are produced, without applying any cement, grout or other coating. Rubbing will not be permitted when the air temperature is expected to fall below 40 degrees F. Rubbing may be performed by use of approved power equipment and tools, providing that the operational procedures shall produce the same desired effects as hand rubbing.

3.2 PROTECTION FROM AND REMOVAL OF STAINS

- A. On mock-up where directed by the Architect, demonstrate methods of rust stain removal in accordance with recommendations of ACI 303 Chapter 10, Section 10.4.
- B. Comply with requirements of Section 033000, CAST-IN-PLACE CONCRETE, and procedures used in construction of accepted mock-ups.

END OF SECTION

SECTION 033515
CONCRETE FINISHING

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. Concrete sealer.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for concrete substrates.
 - 2. Section 099000 - PAINTING AND COATINGS for paints applied to concrete substrates.

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 for floors, and 0.46 for ramps.

1.4 SUBMITTALS

- A. Product Data: For each system indicated.
 - 1. Material List: Indicate each material and cross-reference specific coating, finish system, and application.
 - 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - 3. Include manufacturer's documentation for static coefficient of friction indicating compliance with values specified in this Section.
- B. Samples for Verification: Submit two eight 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.
- D. Maintenance Data: For finish flooring to include in maintenance manuals. Include Product Data for floor-care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in concrete finishing 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. Freestanding Mock-Ups: Refer to Section 014330 - MOCK-UPS for requirements.

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.
- 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. Comply with manufacturer's recommendations for application conditions and temperatures.
- B. Close areas to traffic during system application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Concrete Sealer:
 - a. Curecrete Chemical Company, Inc.
 - b. Euclid Chemical Company, Inc.
 - c. GCP Applied Technologies (formerly W.R. Grace).
 - d. L & M Construction Chemicals

2.2 CONCRETE SEALER

- A. Concrete Sealer: Water-based, chemically reactive transparent sealer for concrete, formulated to penetrate concrete surface to control curing, increase hardness and provide a permanent seal.

Sealer shall react chemically with salts in the concrete to prevent release of concrete dust and neutralize alkali in the concrete.

B. Performance Criteria:

1. Abrasion, per ASTM C779: Minimum 30% increase in abrasion resistance.
2. Hardness:
 - a. Increase in compressive strength of surface, per ASTM C39: minimum 40% increase in compressive strength at 7 days and 35% increase at 28 days over strength of untreated samples.
 - b. Impact resistance, per ASTM C805-Schmidt hammer: Minimum 13% increase in impact resistance.
3. Weathering, per ASTM G23-81: No measurable adverse effect from ultraviolet light, nor from water spray.

C. Basis-of-Design Product: Curecrete Chemical co., Inc., Ashford Formula.

2.3 MIXING

- A. Floor Finish System: Mix concrete floor finish system materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of concrete floor finish system.
- B. Verify that base concrete slabs comply with surface requirements specified in Section 033000 - CAST-IN-PLACE CONCRETE.
- C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D 4263.
- D. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 CONCRETE SEALER APPLICATION

- A. Apply sealer to saturate concrete surface, in strict accordance with manufacturer's recommendations. Sealer may be spray-applied, or poured and broomed.
- B. Surface Preparations: Sweep all areas to be treated with a fine bristle broom or scrub. Hose off with water and allow to dry.
- C. Application to New Concrete:
 1. Apply sealer following concrete finishing operation, as soon as the surface is firm enough to walk on, and before hairline checking and temperature cracking begin. Keep the entire surface wet with sealer for 30 minutes.

2. When sealer becomes slippery, lightly mist the surface with water.
3. When the sealer again becomes slippery, thoroughly flush the entire surface with water and squeegee the surface completely dry to remove all surface alkali or sealer residue.

D. Application to Cured Concrete:

1. Apply sealer to entire surface to saturation. Keep the entire surface wet with sealer for 30 minutes.
2. If, after 30 to 40minutes, most of the sealer has been absorbed into the surface, broom or squeegee any excess material from all low spots and puddles so that all remaining sealer is entirely absorbed into the concrete or totally removed from the surface..
3. If, after 30 to 40minutes, most of the sealer is still on the surface, wait until it becomes slippery, then thoroughly flush the entire surface with water and squeegee the surface completely dry to remove all surface alkali or sealer residue.

E. Cleaning: Wash or wet mop sealed concrete floor with a neutral or high pH detergent.

3.3 PROTECTING AND CURING

- A. General: Protect freshly placed concrete floor finish system from premature drying and excessive cold or hot temperatures.
- B. Cover all concrete finishes with construction paper or plywood to protect them from construction traffic.

3.4 REPAIRS

- A. Defective Finish system: Repair and patch defective concrete floor finish system areas, including areas that have not bonded to concrete substrate.

END OF SECTION

SECTION 034100

PLANT-PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies plant-precast structural concrete units, including the following:
 - 1. Hollow-core slab units.
 - 2. Long-span units.
 - 3. Structural framing units.
- 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; joint filler materials for fire-resistance-rated construction.
 - 2. Section 079200 – JOINT SEALANTS; elastomeric joint sealants and sealant backings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixes: For each concrete mixture, submit proposed mix proportions and test results confirming mix meets requirements stated below. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - 2. Indicate amount of fly ash in the mix.
- C. Shop Drawings: Detail fabrication and installation of precast structural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, openings, and types of reinforcement, including special reinforcement.
 - 1. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
 - 2. Indicate locations and details of anchorage devices to be embedded in other construction.
- D. Samples: For each type of finish indicated on exposed surfaces of precast structural concrete units, in sets of 3, illustrating quality of finishes, colors, and textures; approximately 12 by 12 by 2 inches.
- E. Samples of bearing pads.
- F. Welding Qualifications: Copies of qualifications for welding procedures and personnel.

- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- H. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Concrete materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.
- I. Inspection and test reports from independent testing agency.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed precast structural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance. Plant certification is required by Precast Concrete Institute; plant subject to inspection by the Resident.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- D. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete".
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products".
- F. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.4, "Structural Welding Code--Reinforcing Steel".
- G. Calculated Fire Resistance: Where indicated, provide precast structural concrete units whose fire resistance has been calculated according to PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete", or ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies", and is acceptable to authorities having jurisdiction.
- H. Fire-Test-Response Characteristics: Provide precast structural concrete units that comply with the following requirements:
 - 1. Fire-response testing was performed by UL, ITS or another testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.

2. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory", from ITS's "Directory of Listed Products" or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver precast structural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.
- B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

1.5 SEQUENCING

- A. Furnish anchorage items to be embedded in other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 MOLD MATERIALS

- A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:
 1. Steel Reinforcement: ASTM A 615/A 615M, Grade 60, deformed.
- D. Steel Bar Mats: ASTM A 184/A 184M, assembled with clips, as follows:
 1. Steel Reinforcement: ASTM A 615/A 615M, deformed bars.
- E. Plain-Steel Wire: ASTM A 82, galvanized.
- F. Deformed-Steel Wire: ASTM A 496.
- G. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from galvanized steel wire into flat sheets.

- H. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- I. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice", PCI MNL 116, and as follows:
 - 1. For uncoated reinforcement, use CRSI Class 1 plastic-protected bar supports.
 - 2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.3 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, Grade 250 or 270, uncoated, 7-wire, low-relaxation strand.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type III cement mitigated with a pozzolan to prevent alkali-silica reactivity.
- B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33.
- C. Lightweight Aggregates: ASTM C 330.
- D. Water: Potable, free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Fly Ash Admixture: ASTM C 618, Class C only.
- G. Silica Fume Admixture: ASTM C 1240.

2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type A or B, with arc shields.
- C. Malleable Steel Castings: ASTM A 47.
- D. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
- E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

- F. Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, and ASTM A 153/A 153M, as applicable.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
- G. Welding Electrodes: Comply with AWS standards.
- H. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast structural concrete units.

2.6 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless steel washers.
- C. Stainless-Steel Headed Studs: ASTM A 276.

2.7 BEARING PADS

- A. Provide bearing pads for precast structural concrete units as follows:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer, minimum tensile strength 2250 psi per ASTM D 412.
 - 2. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to mild-steel plate, of type required for in-service stress.

2.8 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I or II, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application.

2.9 CONCRETE MIXES

- A. Prepare design mixes for each type of concrete required.
 - 1. Limit use of fly ash and silica fume to not exceed, in aggregate, 25 percent of Portland cement by weight.

- B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318.
- D. Normal-Weight Concrete: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 - 3. Slump: 4 inches maximum.
 - 4. Units subject to freeze-thawing shall be air-entrained. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows, with a tolerance of plus or minus 1-1/2 percent:
 - a. Air Content: 3 to 6 percent.
- E. Lightweight Concrete: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft. (48 kg/cu. m), according to ASTM C 567.
 - 3. Add air-entraining admixture at manufacturer's prescribed rate to result in lightweight concrete at point of placement having an air content as follows:
 - a. Air Content: 4 to 6 percent for 3/4-inch-nominal maximum aggregate size.
- F. Other Admixtures: Use water-reducing, high-range water-reducing, water-reducing and accelerating, or water-reducing and retarding admixtures according to manufacturer's written instructions.
- G. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.10 FABRICATION

- A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances.
 - 1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's written instructions.
 - 2. Unless forms for precast, prestressed concrete units are stripped before detensioning, design forms so stresses are not induced in precast concrete units because of deformation or movement of concrete during detensioning.

- B. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.
- C. Cast-in openings larger than 10 inches in diameter or 10 inches square according to Shop Drawings. Smaller holes may be field cut by trades requiring them, as approved by Resident.
- D. Reinforcement: Comply with recommendations in Concrete Reinforcing Steel Institute's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
 - 2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
 - 3. Place reinforcement to obtain at least the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
 - 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Prestress tendons for precast structural concrete units by either pretensioning or posttensioning methods. Comply with Precast Concrete Institute MNL 116.
 - 1. Delay detensioning until concrete has reached at least 70 percent of its compressive strength as established by test cylinders cured under the same conditions as concrete.
 - 2. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 - 3. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- F. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.
- H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.
- I. Comply with ACI 306.1 procedures for cold-weather concrete placement.
- J. Comply with ACI 305R recommendations for hot-weather concrete placement.
- K. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast concrete unit on a surface that will not show in finished structure.

- L. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.
- M. Product Tolerances: Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product tolerances.
- N. Finish formed surfaces of precast structural concrete as indicated for each type of unit, and as follows:
 - 1. Commercial Finish: Remove fins and large protrusions and fill large holes. Rub or grind ragged edges. Faces are to be true, well-defined surfaces.
- O. Screed finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections.
 - 1. Apply scratch finish to precast concrete units that will receive concrete topping after installation. After initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.
- P. Recess prestressing tendons a minimum of 1/2 inch, fill recesses with grout, and apply a sack finish to vertical ends of precast concrete units.

2.11 LONG-SPAN UNITS

- A. Type: Plant-fabricated, precast, prestressed concrete long-span units.
- B. Furnish units free of voids and honeycombs.
- C. Provide standard finish to precast concrete units, unless otherwise indicated.
 - 1. If designed as composite members, broom or rake top finish of precast concrete units for bonding with concrete floor topping.
 - 2. If used as roof members, provide smooth, float top finish to precast concrete units.
- D. Reinforce units to resist transportation and erection stresses.
- E. Include cast-in weld plates where required.
- F. Coordinate with other trades for installation of cast-in items.

2.12 STRUCTURAL FRAMING UNITS

- A. Type: Precast, prestressed structural concrete framing units.
- B. Furnish units free of voids and honeycombs.
- C. Provide standard finish to precast concrete units.
- D. Reinforce units to resist transportation and erection stresses.

- E. Include cast-in weld plates where required.
- F. Coordinate with other trades for installation of cast-in items.

2.13 SOURCE QUALITY CONTROL

- A. Contractor shall engage an independent testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
 - 2. Notification Point - Notify Resident at least 3 days in advance of testing. Testing may be witnessed by the Resident.
- B. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.
- C. Strength of precast concrete units will be considered deficient if units fail to comply with PCI MNL 116 requirements, including the following:
 - 1. Units fail to comply with compressive-strength test requirements.
 - 2. Reinforcement and prestressed tendons of units do not comply with fabrication requirements.
 - 3. Concrete curing and protection of units against extremes in temperature fail to comply with requirements.
 - 4. Units are damaged during handling and erecting.
- D. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with PCI MNL 116 requirements, Contractor shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.
 - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Resident.
 - 2. Cores will be tested, after immersion in water, in a wet condition per ACI 301 if units will be wet under service conditions.
 - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75 percent of the 28-day design compressive strength.
 - 4. Test results will be made in writing on the same day that tests are performed, with copies to Resident, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

- E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Dimensional Tolerances: Units with dimensions smaller or larger than required and not complying with tolerance limits may be subject to additional testing.
 - 1. Precast concrete units with dimensions larger than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to comply with construction conditions.
- G. Defective Work: Precast concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bearing Pads: Install bearing pads as precast concrete units are being erected. Set pads on true, level, and uniform bearing surfaces and maintain in correct position until precast concrete units are placed.
- B. Install precast structural concrete. Shore and brace precast concrete units to maintain location, stability, and alignment until permanent connections are installed.
- C. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders using qualified welding procedures.
 - 1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
 - 2. Repair damaged metal surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces.
 - 3. Repair damaged metal surfaces by cleaning and repriming damaged painted surfaces.
- D. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Engineer.
- E. Erection Tolerances: Install precast concrete units level, plumb, square, and true, without exceeding the recommended erection tolerances in PCI MNL 127, "Recommended Practice for Erection of Precast Concrete".

- F. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:
1. Provide forms or other approved method to retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 FIELD QUALITY CONTROL

- A. Testing: Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections.
- B. Notification Point - Field welds and connections using high-strength bolts will be subject to tests and inspections. Notify the Resident 24 hours in advance of high-strength bolting.
- C. Testing agency will report test results promptly and in writing to Contractor and Resident.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.4 CLEANING

- A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.
 1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION

SECTION 044200
EXTERIOR STONE CLADDING

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. Dimension stone panels set with individual anchors.
- 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 joints in dimension stone cladding system with elastomeric sealants.

1.3 DEFINITIONS

- A. Definitions contained in ASTM C 119 apply to this Section.
- B. Dimension Stone Cladding System: An exterior wall covering system consisting of dimension stone panels together with the anchors, backup structure, sheathing, mortar, fasteners, and sealants used to secure the stone to the building structure and to produce a weather-resistant covering.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Design stone anchors and anchoring systems according to ASTM C 1242.
- B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Wind Loads: Determine loads based on Code requirements.
 - 2. Equipment Loads: Allow for loads due to window cleaning and maintenance equipment.
- C. Seismic Performance: Provide dimension stone cladding system capable of withstanding the effects of earthquake motions determined according to local State Building Code.
- D. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface

temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants and 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 ambient; 180 deg F material surfaces.
- E. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.
- F. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
1. Safety Factors for Granite: 3 for uniform loads and 4 for concentrated loads.
- G. Design stone anchors to withstand loads indicated without exceeding allowable working stresses established by the following:
1. For Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
 2. For Cold-Formed Steel: AISI SG-973, Part V, "Specification for the Design of Cold-Formed Steel Structural Members."
 3. For Cast-in-Place and Postinstalled Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
 4. For Post-Installed Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.
- H. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to the following maximums:
1. 1/16 inch, measured in plane of wall.
 2. 1/720 of assembly's clear span but not more than 1/4 inch (6 mm), measured perpendicular to wall.
- I. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system.
- J. Provision for Deflection of Building Structure: Allow for the following:
1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4-inch vertical deflection in 20-foot span of structural members supporting dimension stone cladding system.
 2. Live Load Deflection: Allow for 1/4-inch vertical deflection, in 20-foot span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.
- K. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.5 SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and other manufactured products indicated.
- B. Shop Drawings: Include plans, elevations, and details for all conditions. Show details of fabrication and installation of dimension stone cladding system, including dimensions and profiles of stone units.
 - 1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
 - 2. Include details of mortar joints, sealant joints, and mortar joints pointed with sealant.
 - 3. Show locations and details of anchors and backup structure.
 - 4. For installed dimension stone cladding systems indicated to comply with certain design loads and deflection limits, include structural analysis data signed and sealed by the qualified structural engineer responsible for their preparation.
 - 5. Show adjacent construction for coordination purposes during construction.
- C. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than 12 inches square. Include two or more Samples in each set showing the full range of variations in appearance characteristics expected in the completed Work.
- D. Colored Pointing Mortar Samples for Verification: For each color required, showing the full range of exposed color and texture expected in the completed Work.
- E. Qualification Data: For firms and persons specified in “Quality Assurance” Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. 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.
- G. Material Test Reports: From a qualified independent testing agency indicating and interpreting test results of the following for compliance with requirements indicated:
 - 1. Stone Test Reports: For each stone variety proposed for use on Project, provide test data indicating compliance with required physical properties including those specified by reference to ASTM standards. Include test data for flexural strength based on testing according to ASTM C 880, performed on specimens representative of minimum thickness and finish of installed stone, in both wet and dry conditions. Base reports on testing done within previous five years.
 - 2. Anchorage Test Reports: For each variety, finish and anchor type, based on testing according to ASTM C 1354, performed on specimens representative of minimum thickness and finish of installed stone.
 - 3. For metal components, indicate chemical and physical properties of metal.
 - 4. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Section 079200 - JOINT SEALANTS. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

5. Preconstruction Sealant Field Test Report: From Installer, complying with requirements in Section 079200 - JOINT SEALANTS.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Installer Qualifications: An experienced installer who has completed dimension stone cladding systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 1. Installer's responsibilities include engineering, fabricating, and installing dimension stone cladding system.
 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified structural engineer.
- C. Structural Engineer Qualifications: A structural engineer who is legally qualified to practice in the state that the 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 dimension stone cladding systems that are similar to those indicated for this Project in material, design, and extent.
- D. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
 1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.
- E. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.
- F. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.
- G. Preconstruction Stone Testing: The Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by the Owner. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
 1. Furnish test specimens selected by testing agency from blocks representative of actual materials proposed for incorporation into the Work.
 2. One set of test specimens will be required for each stone variety, of number and size indicated in referenced standards.
 3. Stone will be tested for compliance with physical property requirements according to referenced ASTM standards.
 4. Flexural Strength Tests: ASTM C 880, performed on specimens representative of minimum thickness and finish of installed stone. One set will be tested in both wet and dry conditions.

5. Anchorage Tests: ASTM C 1354, performed on specimens representative of minimum thickness and finish of installed stone. One set will be tested for each combination of stone variety, finish, and anchor type.
 6. Testing agency will report test results in writing to Architect and Contractor.
- H. Welding Standards: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3, "Structural Welding Code--Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.8 PROJECT CONDITIONS

- A. Cold-Weather Construction: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions. When ambient temperature is within limits indicated, use the following procedures:
1. At 40 deg F and below, produce mortar temperatures between 40 and 120 deg F by heating mixing water and, at temperatures of 32 deg F and below, sand. In heating mortar materials, maintain mixing temperatures within 10 deg F do not heat water to above 160 deg F. Maintain temperature of mortar on boards above freezing. Do not apply mortar to stone units or substrates below 32 deg F.
 2. At 25 to 20 deg F heat both sides of walls under construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph.
 3. At 20 deg F and below, provide enclosure and auxiliary heat to maintain air temperature above 32 deg F within enclosure. Heat stone so it is above 40 deg F at time of installation.
- B. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection:
1. 40 to 25 Deg F: Cover dimension stone cladding with a weather-resistant membrane for 48 hours after construction.
 2. 25 to 20 Deg F: Cover dimension stone cladding with insulating blankets or provide enclosure and heat to maintain air temperature above 32 deg F within enclosure for 48 hours after construction. Use windbreaks or enclosures when wind velocity exceeds 15 mph.

3. 20 Deg F and below: Provide enclosure and heat to maintain air temperature above 32 deg F within enclosure for 48 hours after construction.

PART 2 - PRODUCTS

2.1 STONE, GENERAL

- A. Varieties and Sources: Subject to compliance with requirements, provide one of the stone varieties specified for each stone type in Part 2 "Stone Types" Article.
- B. Match Architect's samples for variety, color, finish, and other stone characteristics relating to aesthetic effects.
- C. Provide stone that is free of cracks, seams, and starts impairing structural integrity or function.
- D. Provide stone from a single quarry for each variety of stone required.
- E. Quarry stone in a manner to ensure that as-quarried block orientations yield finished stone with required characteristics.
- F. Make stone slabs available for Architect to examine for appearance characteristics.
 1. Architect will select aesthetically acceptable slabs and will indicate aesthetically unacceptable slabs and portions of slabs.
 2. Segregate slabs selected for use on Project and mark backs indicating approval.
 3. Mark and photograph aesthetically unacceptable portions of slabs as directed by Architect.

2.2 STONE TYPES

- A. Granite: Provide granite complying with ASTM C 615 and NBGQA's "Specifications for Architectural Granite" and as follows:
 1. Varieties, Cut and Finish: J.C. Stone; Oak Hill Grey with thermal finish.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate: ASTM C 144; except for joints narrower than 1/4 inch and pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
 1. White Aggregates: Natural white sand or ground white stone.
 2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other durable stone; of color necessary to produce required mortar color.

- D. Mortar Pigments: Natural and synthetic iron oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar and containing no carbon black.
- E. Water: Potable.

2.4 VENEER ANCHORS

- A. Materials:
 - 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
 - 2. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 316.
- B. Configuration: Kerf anchors at top and bottom of stone panels as indicated on Drawings.
- C. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel. Mill-galvanized wire may be used at interior walls, unless otherwise indicated.

2.5 EMBEDDED FLASHING MATERIALS

- A. Metal Flashings: Furnished under Section 076200 - SHEET METAL FLASHING AND TRIM.

2.6 STONE ACCESSORIES

- A. Setting Buttons: Lead or resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting button.
- B. Setting Shims: Strips of resilient plastic nonstaining to stone, sized to suit joint thicknesses and depths of stone supports without intruding into required depths of joint sealants or causing third-side adhesion between sealant and setting shims.
- C. Concealed Sheet Metal Flashing: Fabricate from stainless steel complying with requirements specified in Section 076200 - SHEET METAL FLASHING AND TRIM in thicknesses indicated, but not less than 0.0156 inch thick.
 - 1. At Contractor's option, fabricate flashing from lead for installation in locations where flashing rests on continuous members.
- D. Weep and Vent Tubes: Rectangular, cellular, polypropylene or clear butyrate extrusion, 3/8 by 1-1/2 inches and of length required to extend from exterior face of stone to cavity behind.
- E. Plastic Weep Hole/Vent: One-piece, flexible extrusion manufactured from ultraviolet-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, in color selected from manufacturer's standard.

2.7 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.8 STONE FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
 - 1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
- B. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 - 1. Minimum Thickness: Provide stone units of not less than dimensions indicated on the Drawings.
 - 2. Control depth of stone and back check to maintain minimum 1 inch clearance between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.
 - 3. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated.
 - 4. Cut stone to produce joints of uniform width and in locations indicated.
 - 5. Clean backs of stone to remove rust stains, iron particles, and stone dust.
- D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.
- E. Fabricate molded work, including washes and drips, to produce stone shapes with a uniform profile throughout entire unit length, with precisely formed arris slightly eased to prevent snipping, and with matching profile at joints between units.
 - 1. Produce moldings with machines having abrasive shaping wheels made to reverse contour of molding shape; do not sculpt moldings.
- F. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match approved samples and mockups.

- G. Pattern Arrangement: Fabricate and arrange panels with veining and other natural markings to comply with the following requirements:
 - 1. Cut stone from one block or contiguous, matched blocks in which natural markings occur.
 - 2. Arrange panels with veining as indicated on Drawings.
- H. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
 - 1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.9 SHOP-PAINTED STEEL FINISHES

- A. General: Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting backup structure.
- B. Surface Preparation: After completing fabrication of steel items, prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Apply 2-coat high-performance coating system consisting of organic zinc-rich primer, complying with SSPC-Paint 20, at 2.5-mil dry film thickness and topcoat of high-build, 2-component, epoxy-polyamide, high-performance coating at 6-mil dry film thickness.
- D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. High-Performance Coating Systems:
 - a. Carboline 621 and 190 HB; Carboline Company.
 - b. Aquapon Zinc-Rich Primer 97-670 and High-Build Polyamide-Epoxy 97-131; PPG Industries, Inc.
 - c. Tneme-Zinc 90-97 and Series 69 Hi-Build Epoxoline II; Tnemec Company, Inc.

2.10 MORTAR MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
 - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
 - 2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.

- B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:
 - 1. Set granite with Type S mortar.
- C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, Type N unless indicated otherwise. Provide pointing mortar mixed to match Architect's sample and complying with the following:
 - 1. Pigmented Pointing Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Protect dimension stone cladding during erection as follows:
 - 1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
 - 2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
 - 3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
 - 4. Protect sills, ledges, and projections from mortar and sealant droppings.
- C. Clean stone surfaces that are dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING DIMENSION STONE CLADDING, GENERAL

- A. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.
 - 1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.
- B. Contiguous Work: Provide reveals, reglets, and openings as required to accommodate contiguous work.
- C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- D. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 - 1. Sealing expansion and other joints is specified in Section 079200 - JOINT SEALANTS.
 - 2. Keep expansion joints free of mortar and other rigid materials.
- E. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water to divert water to building exterior.
- F. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.
 - 1. Place weep holes and vents in joints where moisture may accumulate, including base of cavity walls, above shelf angles, and flashing. Locate weep holes and vents at intervals not exceeding 24 inches and for those serving as vents only, at intervals not exceeding 60 inches horizontally and 20 feet vertically.

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, corners and jambs within 20 feet of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch in 40 feet or more.
- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
- C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch.

- E. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or a quarter of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch difference between planes of adjacent units.

3.5 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

- A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.
- B. Attach framing for stone support system to structural frame of building, at connection points indicated, by welding or bolting to comply with the following:
 - 1. Weld connections to comply with AWS D1.1, "Structural Welding Code--Steel."
 - 2. Fabricate joints to exclude water or to permit its escape to building exterior, at locations where water could accumulate because of condensation or other causes.
 - 3. For galvanized surfaces, clean welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
 - 4. For shop-painted surfaces, clean field welds, bolted connections, and abraded areas immediately after erection. Apply paint to exposed areas using same material as used for shop painting.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of stone a distance at least equal to width of joint.

3.6 FIELD QUALITY CONTROL

- A. Field Quality-Control Testing Service: Owner will engage a qualified independent testing agency to perform field quality-control testing. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Water Leakage: Dimension stone cladding system will be tested according to AAMA 501.2.
- C. Testing agency will report test results promptly and in writing to Architect and Contractor.

3.7 ADJUSTING AND CLEANING

- A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.
- B. Replace in a manner that results in dimension stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

- C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints.
- D. Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION

SECTION 050800
GALVANIZING AND METAL FINISHES

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. Hot-dip galvanizing and factory-applied architectural finish for iron and steel fabrications.

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

- 1. Section 051200 - STRUCTURAL STEEL FRAMING for structural steel items.
 - 2. Section 051250 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL.
 - 3. Section 055000 - METAL FABRICATIONS.
 - 4. Section 055100 - METAL STAIRS AND RAILINGS.
 - 5. Section 099000 - PAINTING AND COATING for field painting.

1.3 SUBMITTALS

- A. Product Literature: Submit galvanizer's product literature for coatings specified in this Section including test data.
- B. Verification Samples: Submit two 3 inch by 6 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.
- C. Certificate of Compliance for Items Coated by Galvanizer: If requested, submit notarized Certificate of Compliance with application for payment for galvanizing, signed by the galvanizer, indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.

1.4 QUALITY ASSURANCE

- A. Galvanizer' Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of ten years experience in the successful application of galvanized coatings specified in this specification in the facility where the work is to be performed and who will apply the coatings within the same facility.

- B. Coating Applicator's Qualifications: Galvanizing and factory-applied coatings shall be performed by a company with a minimum of ten years experience in the successful application of hot-dip galvanizing utilizing the dry kettle process.
- C. Pre-Construction Conference for Metal Fabrications to Receive Factory-Applied Metal Coatings: Contractor shall schedule a meeting to be attended by Contractor, Architect, fabricator, and galvanizer. Agenda shall include the following: Project schedule, scope of services, coordination between fabricator and galvanizer, finish of surfaces, application of coatings, color selections, submittals, and approvals.
- D. Coordination between Fabricator and Galvanizer: Prior to fabrication and final submittal of shop drawings to Architect, direct fabricators to submit shop drawings to the galvanizer for all metal fabrications to receive factory-applied metal coatings. Direct galvanizer to review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications required to be performed by the fabricator.
- E. Environmental Compliance: Coatings shall be certified OTC/VOC compliant and conform to EPA standards and local regulations.

PART 2 - PRODUCTS

2.1 COATING APPLICATOR

- A. Coating Applicator: For the purpose of establishing a standard of quality and performance, provide factory-applied metal coatings by Duncan Galvanizing.

2.2 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.

2.3 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

- 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 earthy materials.
 - 5. Fill vent holes after galvanizing, if applicable, and grind smooth.
- B. Architectural Finish: 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: Colorgalv by Duncan Galvanizing.

2. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
3. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer. Finish coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
4. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.
5. Apply the galvanizing, primer, and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
6. Clean galvanized surface to create an acceptable profile for coatings. Galvanizer shall certify that performance will be met without blast cleaning and coating will be applied within 12 hours of galvanizing at the galvanizer's plant. If blasted, galvanizer shall certify that rugosity standards are met.
7. Primer shall meet or exceed the following performance criteria:
 - a. Abrasion Resistance per ASTM D 4060 (CS17 Wheel, 1,000 grams load),1kg Load: 200 mg loss.
 - b. Adhesion per ASTM D4541: 1050 psi.
 - c. Corrosion Weathering per ASTM D5894, 13 Cycles, 4,368 Hours: Rating 10 per ASTM D714 for blistering; Rating 7 per ASTM D610 for rusting.
 - d. Direct Impact Resistance per ASTM D2794: 160 in. lbs.
 - e. Flexibility per ASTM D522, 180° Bend, 1 in. Mandrel: Passes.
 - f. Pencil Hardness per ASTM D3363: 3B.
 - g. Moisture Condensation Resistance per ASTM D4585, 100° F, 2000 Hours: Passes, no cracking or delamination.
 - h. Dry Heat Resistance per ASTM D2485: 250° F.
8. Topcoat shall meet or exceed the following performance criteria:
 - a. Abrasion Resistance per ASTM D 4060, CS17 Wheel, 1,000 Cycles 1kg Load: 87.1 mg loss.
 - b. Adhesion per ASTM D 4541: 1050 psi.
 - c. Direct Impact Resistance per ASTM D2794: >28 in. pounds.
 - d. Indirect Impact Resistance per ASTM D2794: 12-14 in. pounds.
 - e. Dry Heat Resistance per ASTM D2485: 200° F.
 - f. Salt Fog Resistance per ASTM B 117 9,000 Hours: Rating 10 per ASTM D714 for blistering.
 - g. Flexibility per ASTM D522, 180° Bend, 1/8 in. Mandrel: Passes.
 - h. Pencil Hardness per ASTM D3363: 2H.
 - i. Moisture Condensation Resistance per ASTM D4585, 100° F, 1000 Hours: No blistering or delamination Xenon Arc Test per ASTM D 4798: Pass 300 hours

2.4 APPLICATION OF FACTORY-APPLIED METAL COATINGS

- A. Galvanizing Application: Galvanize materials in accordance with specified standards and this specification. Galvanizing shall provide an acceptable substrate for applied coatings. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material.
- B. Prior to galvanizing, the steel shall be immersed in a pre-flux solution (zinc ammonium chloride). The pre-flux tank must be 12 to 14 Baumé density and contain less than 0.4 percent iron. Use of the wet kettle process is not acceptable. To provide the galvanized surface required, the following procedures shall be implemented:
 - 1. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.
 - 2. The pickling tanks shall contain hydrochloric acid with an iron content less than 8 percent and zinc content less than 3 percent. Titrations shall be taken weekly at a minimum.
 - 3. All chemicals and zinc shall be tested at least once a week to determine compliance with ASTM standards. All testing shall be done using atomic absorption spectrometry or x-ray fluorescence (XRF) equipment at a lab in the galvanizing plant.
- C. Finish coatings shall be applied under the following conditions.
 - 1. Minimum air temperature shall be 65 degrees F. Surface temperature of steel shall be 60 degrees to 95 degrees F and, in any event, be 5 degrees F higher than the dew point. Humidity shall be 85 percent maximum.
 - 2. The use of iron or steel shot and sand and aluminum oxide grit as a blast medium, and power wire brushes are not permitted.
 - 3. Surface of substrate shall be dry and free from dust, dirt, oil, grease or other contaminants. Coating and cure facility shall be maintained free of airborne dust and dirt until coatings are completely cured.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-coated materials.
- B. Touch-Up and Repair: 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. Galvanizing repair paint shall have 95 percent zinc by weight, ZiRP by Duncan Galvanizing. 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 for warranties to apply. Touch-up shall be such that repair is not

visible from a distance of 6 feet. If non factory-approved technicians are used for field touch-up, no warranties shall exist.

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 051000

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items.
 - 1. Structural steel.
- B. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections
 - 1. Section 03300 - CAST-IN-PLACE CONCRETE: Lintels, sleeves, anchors, inserts, embedded wall plates, loose leveling plates and similar items.
- C. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 050800 – GALVANIZING AND METAL FINISHES: Galvanization and factory-applied coating systems.
 - 2. Section 09900 - PAINTING: Finish painting of exposed structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges", that support design loads.
- B. Architecturally Exposed Structural Steel: Structural steel that forms a prominent architectural feature in a building or structure or designated as architecturally exposed structural steel on the Drawings.

1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by the structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using the American Institute of Steel Construction's (AISC) "Specification for Structural Steel Buildings" (AISC 360-10) and the "Code of Standard Practice for Steel Buildings and Bridges" (AISC 303-10)
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer, registered in Maine, to prepare structural analysis data for structural-steel connections.

1.4 SUBMITTALS

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

- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld.
 4. Indicate type, size and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer, registered in Maine, responsible for their preparation.
- C. Welding Certificates: Certificate from AWS indicating certification in type of welding required for each welder and welding operator.
- D. Welding Records and Data:
1. Before welding, submit the procedure which will be used for qualifying welders and welding procedures. For procedures other than those pre-qualified in accordance with AWS D1.1, submit a copy of procedure qualification test records.
 2. Submit certified copy of qualification test records for each welder, welding operator, and tacker who will be employed in the work.
 3. If field welding is permitted, submit descriptive data for field welding equipment.
 4. Submit all NDE records (radiographs, ultrasonic, magnetic particle) and visual inspection reports upon completion or when otherwise requested by the Resident.
- E. Qualification Data: For installer, fabricator, professional engineer, testing agency, welding inspectors, NDE inspectors and galvanizer. Submit prior to starting work.
- F. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Direct-tension indicators.
 4. Tension-control, high-strength bolt-nut-washer assemblies.
 5. Shear stud connectors.
 6. Shop primers.
 7. Nonshrink grout.
- G. Erection Procedure:
1. Within sixty days of the date of the Notice to Proceed, the Contractor shall submit an erection procedure. The submitted method of erection is subject to review, comment and approval by the Engineer. The method must be submitted with a detailed procedure which includes drawings and calculations sufficient to enable the Engineer to determine the adequacy of the proposed method.
 2. The method and all submissions shall be prepared under the supervision of a Professional Engineer, registered in Maine, who is familiar with these specifications, AASHTO, AISC, the work and experienced in this technical field. The erection engineer shall submit proof of experience with erection engineering of for structures of similar complexity and provide a list of

previous projects and references. All submitted sheets shall be stamped by the supervising Professional Engineer. As a minimum, the following information shall be included in the submittal:

- a. Plan showing the location of all roadways, utilities, railroad tracks and other appurtenances in areas of erection.
 - b. The location of cranes, both horizontally and vertically, and their operating radii.
 - c. Lifting equipment information including rating data. Information shall include counter weights to be used and boom capacity. The capacity of the crane and of all lifting and connecting devices shall be adequate for 150% of the total pick weight including spreaders and other material.
 - d. The type, size and arrangement of slings, shackles or other lifting and connecting devices including relative technical data.
 - e. The order of lifts, repositioning of equipment and counterweights, and location and method of attaching deadmen.
 - f. Methods and materials for temporary structures or the strengthening or bracing of a member (either temporarily or permanently) for erection purposes.
3. The stresses shall be investigated at each stage of erection with allowance for Wind Pressure determined from the following table:

| Height of Member above Ground in Feet* | Wind Pressure – Pounds per Square Foot** | |
|--|--|---------|
| | Beams and Girders | Trusses |
| 15 | 21.0 | 31.5 |
| 30 | 25.5 | 38.5 |
| 50 | 28.0 | 42.0 |
| 100 | 32.0 | 48.0 |
| 300 | 39.0 | 58.5 |

*For other heights, wind pressures shall be interpolated

4. Erection drawings shall show bolting or welding procedures necessary to complete erection. Procedures shall include sequence and method of connecting main members and secondary members. For stringer and truss spans, the following minimum information shall be included in the notes, modified as necessary to conform to design and erection requirements for each structure:
- a. Splices and field connections of main stress carrying members shall be made with a minimum of 50% of the holes at each connection filled with approved high strength bolts and erection pins before the external support system is released. At least one-half of this percentage shall be bolts, tightened to specification requirements. The bolts and pins shall be installed uniformly throughout the connection except that erection pins shall be used in the extreme corners of all main connections.
 - b. Members to be assembled on the ground before erection shall be blocked to their proper “no load profile” and 100 percent of the approved high strength bolts shall be installed and tightened to the specification requirements before erecting the member.
 - c. All diaphragms, cross frames, and lateral bracing shall be installed between stringer lines as the work progresses.

- d. Unless otherwise noted, dimensions indicated at expansion joints and similar construction are determined for a temperature of 50 degrees F. Proper adjustments must be made when the structure is placed at any other temperature.
5. Trusses and stringers shall be stabilized with falsework, temporary braces, or holding cranes until a sufficient number of adjacent stringers/trusses are erected with all diaphragms and cross frames connected to provide necessary lateral stability. Care shall be taken in the use of false work and other temporary supports to ensure that the temporary elevation of structural steel provided by the falsework is consistent with the deflections that will occur as the structure is completed.
6. In instances where falsework is required by the contract or proposed as part of the erection procedure, it shall be properly designed, constructed, and maintained for the loads that it will bear. Plans for falsework along with the necessary engineering data shall be submitted to the Engineer for review, comment, and approval under the same guidelines as the erection procedure.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is certified for: Steel Building Structures (STD); or Simple Steel Bridge Structures (SBD); or Major Steel Bridges (CBR) as applicable.
- B. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed and who will apply the coatings within the same facility.
- C. Installer Qualifications: A qualified installer with previous experience in installing structural steel.
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges"
 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2"
 3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" and "Load and Resistance Factor Design Specification for Structural Steel Buildings"
 4. AISC's "Specification for the Design of Steel Hollow Structural Sections"
 5. AISC's "Specification for Allowable Stress Design of Single-Angle Members" and "Specification for Load and Resistance Factor Design of Single-Angle Members"
 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"
- F. Tests and Inspection
 1. The Contractor will test and inspect high-strength bolted connections and welded connections and prepare test reports. Specialty tests shall be performed at no expense to the Authority by an independent testing laboratory approved by the Resident. Costs of specialty tests shall be borne by the Contractor. Test reports shall be submitted to the Resident for approval.

2. The Resident reserves the right to inspect high-strength bolted connections and weld connections. Provide access to places where structural steel work is being fabricated or erected so that required inspection and testing can be accomplished at no change in Contract Price. At times, inspection may require moving or handling of steel to permit proper inspection. Notify Materials Testing Laboratory not less than 48 hours prior to start of fabrication.
3. The Resident may inspect structural steel at the plant before shipment; however, the Resident reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
4. Correct deficiencies in structural steel work that inspections and laboratory test reports have indicated to be not in compliance with requirements at the Contractor's expense. Perform additional tests, at no expense to the Authority, as may be necessary to reconfirm any non-compliance of the original work, and as may be necessary to show compliance of corrected work.
5. Specialty Tests: Nondestructive examination of welds in accordance with provisions of AWS D1.1 and ASTM Standards noted shall be made in accordance with the following schedule:
 - a. Radiographic Examination of Welds, per ASTM E94 and E142:
 - 1) Field, complete joint penetration groove welds:
 - a) 1 out of 5 (20 percent) with thickness equal to or less than 3/4 inch.
 - b) 100 percent with thickness greater than 3/4 inch.
 - 2) Shop, complete joint penetration groove welds:
 - a) 1 out of 10 (10 percent) with thickness equal to or less than 3/4 inch.
 - b) 1 out of 2 (50 percent) with thickness greater than 3/4 inch and equal to or less than 1-1/2 inches.
 - c) 100 percent for thickness greater than 1-1/2 inches.
 - b. Ultrasonic Examination, per ASTM E164: Complete joint penetration groove butt welds not accessible for radiographic examination shall be subjected to ultrasonic testing. The extent shall be the same as noted for radiographic examination. Ultrasonic examination shall be made 48 to 72 hours after welding at locations on weldments or welded joints subject to high restraint as indicated in order to check for lamellar tearing. The exact location of the areas to be inspected shall be determined with the Resident at the time of fabrication. This examination shall be made according to the following schedule unless conditions of tearing require a greater number of tests, as directed:
 - 1) 1 out of 10 (10 percent) for thickness equal to or less than 3/4 inch.
 - 2) 1 out of 5 (20 percent) for thickness greater than 3/4 inch and equal to or less than 1-1/4 inches.
 - 3) 1 out of 2 (50 percent) for thickness greater than 1-1/4 inches.
 - c. Magnetic Particle Examination, per ASTM E709, field and shop:
 - 1) 1 out of 5 (20 percent) of complete joint penetration groove welds of tee and corner joints.
 - 2) 1 out of 10 (10 percent) of partial joint penetration groove and fillet welds.
 - d. Penetrant Examination, per ASTM E165: Shall be used for detecting discontinuities that are open to the surface use as appropriate.
6. Visual Examination: All welds whether otherwise examined or not shall be visually examined and faulty joints shall be marked for correction.
7. When any testing, examination or inspection reveals faulty welds, all joints of the same type shall be checked at no expense to the Authority until the integrity of the weld is assured before resuming examination.
8. After faulty welds have been corrected or repaired, they shall each be re-examined at no expense to the Authority in the manner specified for the original joint.
9. It is intended that inspections shall be performed to permit an orderly flow of completed material from the shop. Work with the Resident to establish a schedule that will permit this.

10. Test result information shall be forwarded to the Resident immediately after test results are available stating the acceptance or rejection of fabricated pieces in order that the repairs and re-inspection may be made as soon as possible.

G. Pre-Installation Conference: Contractor shall schedule a meeting to be attended by Contractor, Engineer, fabricator and galvanizer. Agenda shall include the following: Project schedule, source for each fabrication, coordination between fabricator and galvanizer and adjacent Work, finish of surfaces, application of coatings, submittals, and approvals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and re-lubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION

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

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Channels, Angles, M-Shapes, S-Shapes, W-Shapes: ASTM A 572, Grade 50.

B. Plate and Bar: ASTM A 572/A 572M, Grade 50.

C. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

D. Steel Pipe: ASTM A 53, Type E or S, Grade B.

E. Medium-Strength Steel Castings: ASTM A 27, Grade 65-35 carbon steel.

F. High-Strength Steel Castings: ASTM A 148, Grade 80-50, carbon or alloy steel.

G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: Bolts, nuts and washers shall conform to the appropriate material specification ASTM F3125 Grade 325, ASTM A563, AASHTO M 292M/M 292 and ASTM F436/F436M
 - 1. Finish: Hot-dip zinc coating, ASTM A 153, Class C.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Finish, mechanically deposited zinc coating, ASTM B 695, Class 50.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Anchor Rods: ASTM F 1554, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.
- E. Threaded Rods: ASTM A 193, grade as applicable, hot-dip zinc coating, ASTM A 153, Class C.
- F. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.
- G. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: Coatings meeting requirements of ASTM A 780.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Architecturally Exposed Structural Steel: Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel identified as architecturally exposed structural steel.
 - 1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, seam marks, roller marks, rolled trade names, and roughness.

2. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
 - D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
 - E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
 - F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
 - G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
 - H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10 inches o.c., unless otherwise indicated.
 - I. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Complete welds in accordance with the Contract Drawings.
 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 3. Insufficient welds shall be rejected and corrected until required profiles are met.
 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.

- b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
5. No skip welds will be permitted for steel connections to be coated.

2.6 STEEL PRIMERS AND FINISHES

- A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for The Society for Protective Coatings (SSPC) surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 10/NACE No. 2, "Near White Metal Blast Cleaning"
 2. Interiors (SSPC Zone 1A): SSPC-SP 6, "Commercial 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 09900. Provide primer with a VOC content of 340 g/L (2.8 lb/gal.) or less per OTC ozone standards. Provide Tnemec Series 394 or Ameron 5105 or equal by DuPont or Carboline for exposed steel to be fireproofed, or Tnemec Series 901K97 Series or 90-97 or Ameron 68HS or equal by DuPont or Carboline for exposed steel to be finish painted at 3.0 mils DFT.
- C. Primer for Exposed Steel to Receive Multi-Coat Shop-Applied Coating: Tnemec Series 901K97 or 90-97 urethane zinc rich primer at 3.0 to 3.5 mils DFT, topcoated in shop with Tnemec Series V73 Endura-Shield, or use Ameron Series 68HS Primer at 3.0 to 5.0 mils DFT topcoated in shop with Ameron's Amercoat 450H, or use or equal primers and finish coats from DuPont or Carboline.
- D. 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. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc and other earthly materials. Fill vent holes and grind smooth after galvanizing.
- E. Hot-Dip Galvanizing And Factory-Applied Primer for Steel: Provide hot-dip galvanizing and factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and State of Maine requirements. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria:
 1. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
 2. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
 3. Humidity Resistance: ASTM D 4585.
 4. Salt Spray (Fog): ASTM B 117.

- F. Hot-Dip Galvanizing and Factory-Applied Urethane Primer and Finish for Steel: Provide factory-applied architectural coating over primed hot-dip galvanized steel matching approved samples.
1. Primer coat shall be factory-applied polyamide epoxy primer. Apply primer within 12 hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer.
 2. Finish coat shall be factory-applied color-pigmented architectural finish. Apply finish coating at the galvanizer's plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer.
 3. Coatings shall be certified OTC/VOC compliant and conform to applicable regulations and EPA standards.
 4. Apply the galvanizing, primer and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating.
 5. Blast cleaning of the galvanized surface is not acceptable.
 6. Primer shall meet or exceed the following performance criteria:
 - a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
 - b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
 - c. Humidity Resistance: ASTM D 4585.
 - d. Salt Spray (Fog): ASTM B 117.
 7. Finish coat shall meet or exceed the following performance criteria:
 - a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
 - b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
 - c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish and lipstick.
 - d. Weathering: ASTM D 1014, 45 degrees facing south.
 - e. Surface Burning Characteristics: ASTM E 84
 - f. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
 - g. Salt Spray (Fog): ASTM B 117.
 8. Clearcoat over finish coat shall meet or exceed the following performance criteria:
 - a. Abrasion: ASTM D 4060, CS17 Wheel, 1,000 gram load.
 - b. Adhesion: ASTM D 3359, Method B, 5 mm crosshatch.
 - c. Graffiti Resistance: After drying for seven days, no staining from acrylic, epoxy, epoxy-ester and alkyd spray paints, ballpoint pen, crayons, magic marker, black shoe polish and lipstick.
 - d. Weathering: ASTM D 1014, 45 degrees facing south; and ASTM D 4141C EMMAQUA-NTW.
 - e. QUV: ASTM G53, ES-40 bulbs, 4 hours light, 4 hours dark.
 - f. Salt Spray (Fog): ASTM B 117.
 - g. Flexibility: ASTM D 522, Method B, cylindrical mandrel.
 - h. Hardness: ASTM D 3363 (Pencil).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements. Elevations shall be verified by a surveyor licensed in the State of Maine.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges".
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten or pretension anchor rods as applicable after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges".
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Remove erection bolts and tabs on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.
- G. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint indicated on the Drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 - 4. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
 - a. Grind butt welds flush.
 - b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.
 - c. Re-profile all steel surfaces (using needle guns or other profiling methods) that have been welded and ground smooth to assure proper adhesion of primers and topcoats.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". When using bolted connections prime with "slip critical class B" primer as specified in this Section. All surfaces of bolted or bearing connections may be primed. When welding, hold back primer a minimum of 2 inches each side of weld.
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1. In addition to visual inspection, specialty tests will be performed in accordance with AWS D1.1 and at the frequency stated in Article 1.5.F.5
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

- E. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 051250
ARCHITECTURALLY EXPOSED STRUCTURAL STEEL

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. Requirements for the appearance and surface preparation of architecturally exposed structural-steel.
 2. Requirements in Section 051200 - STRUCTURAL STEEL FRAMING also apply to AESS.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 050800 - GALVANIZING AND METAL FINISHES for painted, galvanized finish.
 2. Section 051200 - STRUCTURAL STEEL FRAMING for additional requirements applicable to AESS.
 3. Section 055000 - METAL FABRICATIONS for other metal items not defined as structural steel.
 4. Section 099100 - PAINTING for surface preparation and priming requirements.

1.3 SUBMITTALS

- A. Shop Drawings: Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections. Indicate orientation of bolt heads.
 5. Indicate exposed surfaces and edges and surface preparation being used.
 6. Indicate special tolerances and erection requirements.

- B. Samples: Submit samples of AESS to set quality standards for exposed welds.
- C. Qualification Data: For qualified fabricator and installer.

1.4 QUALITY ASSURANCE

- A. AESS Quality Standards: Comply with requirements of AISC Code of Standard Practice for Steel Buildings and Bridges, June 15, 2016 edition, Section 10, Architecturally Exposed Structural Steel.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
 - 1. Locate mock-ups on-site or in the fabricator's shop as directed by Architect. Mock-ups shall be full-size pieces unless the Architect approves smaller models.
 - 2. Notify the Architect one week in advance of the dates and times when mock-ups will be available for review.
 - 3. Demonstrate the proposed range of aesthetic effects regarding each element listed under the fabrication heading below.
 - 4. Mock-up will have finished surface (including surface preparation and paint system).
 - 5. Obtain Architect's approval of mock-ups before starting fabrication of final units.
 - 6. Retain and maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.
 - a. Approved mock-ups in an undisturbed condition at the time of Substantial completion may become part of the completed work.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.7 COORDINATION

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Meet requirements of Section 051200 - STRUCTURAL STEEL FRAMING as amended below.
- B. High-Strength Bolts, Nuts, and Washers: Per Section 051200 - STRUCTURAL STEEL FRAMING heavy hex heads and nuts.

2.2 PRIMER

- A. Primer: Provide the following as approved by the Architect:
 - 1. Interior, Polyurethane Primer: Tnemec PermaPrime Series 394, single component Aromatic Polyurethane, Mio-Zinc Filled Primer, the Architect is not aware of any acceptable substitutes.
 - 2. Exterior, Zinc Rich Primer: Equal to Tnemec Tnemec-Zinc 90 Series, as approved by the Architect.

2.3 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. AESS Category for Fabrication and Erection:
 - 1. Level 1: Basic Elements.
 - 2. Level 2: Feature elements not in close view, viewed at a distance greater than 20 feet. This includes the following locations:
 - a. Underside of bridge.
 - 3. Level 3: Feature elements in close view, viewed at a distance of 20 feet or less. This includes the following locations:
 - a. Platform canopy columns, beams, and bracing.
 - b. Bridge column base.
 - c. Underside of bridge roof.
 - d. Exterior bridge truss.
 - 4. Level 4: Not used.

- C. In addition to special care used to handle and fabricate AESS, comply with the following:
1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates.
- D. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.
- E. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch.
- F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.4 SHOP CONNECTIONS

- A. Bolts: Comply with requirements of Section 051200 - STRUCTURAL STEEL FRAMING. Provide bolt type and finish as noted herein and align bolt heads as indicated on the approved shop erection drawings.
- B. Weld Connections: Comply with AWS D1.1 and Section 051200 - STRUCTURAL STEEL FRAMING for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
1. Provide bolt type and finish as noted herein and align bolt heads as indicated on the approved shop erection drawings.

2.5 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections if primer does not meet the specified AISC slip coefficient.
 - 4. Surfaces to receive sprayed fire-resistive materials.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
 - 2. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.6 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

- A. See Section 050800 - GALVANIZING AND METAL FINISHES.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in

intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

1. AESS Erection Tolerances: Erection tolerances shall meet the requirements of Chapter 10 of the AISC Code of Standard Practice.
2. Welds Ground Smooth: Erector shall grind welds smooth in the connections of AESS members. For groove welds, the weld shall be made flush to the surfaces of each side and be within + 1/ 16", -0" of plate thickness.
3. Contouring and Blending of Welds: Where fillet welds are indicated to be ground contoured, or blended, oversize welds as required; grind to provide a smooth transition and to match profile on approved mock-up.
4. Continuous Welds: Where noted on the drawings, provide continuous welds of a uniform size and profile.
5. Minimize Weld Show-Through: At locations where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.
6. Bolt Head Orientation: All bolt heads shall be oriented as indicated on the contract documents. Where bolt-head alignment is specified, the orientation shall be noted for each connection on the erection drawings. Where not noted, the bolt heads in a given connection shall be oriented to one side.
7. Removal of Field Connection Aids: Run-out tabs, erection bolts and other steel members added to connections to allow for alignment, fit-up, and welding in the field shall be removed from the structure. Field groove welds shall be selected to eliminate the need for backing bars or to permit their removal after welding. Welds at run-out tabs shall be removed to match adjacent surfaces and ground smooth. Holes for erection bolts shall be plug welded and ground smooth.
8. Field Welding: Weld profile, quality, and finish shall be consistent with mock-ups approved prior to fabrication.
9. Splice members only where indicated
10. Obtain permission for any torch cutting or field fabrication from the Architect. Finish sections thermally cut during erection to a surface appearance consistent with the mock up.
11. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.

3.4 FIELD CONNECTIONS

A. Bolted Connections: Install bolts of the specified type and finish in accordance with Section 051200 - STRUCTURAL STEEL FRAMING.

- B. Welded Connections: Comply with AWS D1.1 for procedures, and appearance. Refer to Section 051200 - STRUCTURAL STEEL FRAMING for other requirements.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp. Verify that weld sizes, fabrication sequence, and equipment used for AESS will limit distortions to allowable tolerances..
 - 2. Obtain Architect's approval for appearance of welds in repaired or field modified work

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 - STRUCTURAL STEEL FRAMING. The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 053100

STEEL DECK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: This Section specifies the following items.
 - 1. Roof deck.
 - 2. Composite floor deck.
 - 3. Non-composite floor deck

- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 033000 – CAST-IN-PLACE CONCRETE; concrete fill in metal deck.
 - 2. Section 051000 – STRUCTURAL STEEL; shop- and field-welded shear connectors.
 - 3. Section 055000 – MISCELLANEOUS METALS; framing deck openings with miscellaneous steel shapes.

1.2 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welder, tack welder and welding procedure qualifications.
- E. Qualifications of galvanizer and testing and inspection agencies.
- F. Field quality-control and fire resistance test and inspection reports.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel".
- B. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those 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 of applicable testing and inspecting agency.

2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members".

D. Galvanizer Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of five years experience in the successful application of galvanized coatings specified in this Section in the facility where the work is to be performed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Supply manufactured deck units in accordance with the applicable requirements of the Steel Deck Institute as indicated.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with Steel Deck Institute (SDI) "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade G60 zinc coating.
2. Deck Profile and Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 40 minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: 0.0358 inch.
4. Span Condition: As indicated.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Galvanizing Repair Paint: ASTM A 780.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches and as follows:
 - 1. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
 - 1. Fasten with a minimum of 1-1/2-inch-long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: The Contractor shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare inspection and test reports.
- B. Field welds will be subject to visual inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Engineer.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

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 elevator machine beams.
2. Steel support angles for elevator door sills.
3. Miscellaneous steel framing and supports:
 - a. 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. Prefinished slotted steel channel support framing for metal soffit panels.
 - c. Galvanized steel framing and supports for aluminum panel signage.
4. Ladders:
 - a. Galvanized steel elevator pit ladders.
5. Diamond plate panels for elevator flooring.
6. Stainless steel panels at elevator door frames.

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

1. Section 050800 - GALVANIZING AND METAL FINISHES for painted, galvanized finish.
2. Section 051200 - STRUCTURAL STEEL FRAMING for structural steel items.
3. Section 055100 - METAL STAIRS AND RAILINGS for steel stairs, handrails, and guardrails.
4. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
 - 1. For ladders exceeding 24 feet, include loads imposed by fall arrest system.
- C. 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.
 - 3. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.
- 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."
 - 3. 4. AWS D1.2, "Structural Welding Code--Aluminum."

- 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. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304 at interior, Type 316L at exterior.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 at interior, Type 316L at exterior.
- E. 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.
- F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

- G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- H. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-4.
 - 1. Basis of Design: Unistrut Corp.
 - 2. Threaded Rod: Low carbon threaded rod as recommended by framing manufacturer.
- I. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.2 NONFERROUS METALS

- A. Environmental Product Declarations (EPD): Industry-wide EPDs for aluminum extrusions, cold-rolled sheet, and hot-rolled sheet are available from the Aluminum Association.
- B. Aluminum Plate and Sheet: ASTM B 209/B 209M, Alloy 6061-T6.
- C. Aluminum Extrusions: ASTM B 221/221M, Alloy 6063-T6.
- D. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- E. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- F. Aluminum Mesh: Pattern as indicated on Drawings.

2.3 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.

2.4 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: Tnemec; Series 394 PerimePrime, or approved equal.
 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. Duncan Galvanizing; ZiRP.
 - b. 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.
 2. VOC Content: 0 g/L.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, 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.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction 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.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.
3. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted brackets, made from same metal as ladder.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

2.8 DIAMOND PLATE PANELS

- ### A. Aluminum Plate: Minimum 1/8 inch thick aluminum plate with diamond pattern tread plate.

2.9 STAINLESS STEEL PANELS

- ### A. Infill Panels at Elevator Door Frames: As detailed on Drawings.

2.10 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.

2.11 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.

2.12 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.

2.13 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

- A. See Section 050800 - GALVANIZING AND METAL FINISHES.

2.14 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

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.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 - JOINT SEALANTS to provide a watertight installation.

3.4 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 055100

METAL STAIRS AND RAILINGS

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. Cast aluminum stair treads and risers.
 - 2. Detectable warning plates.
 - 3. Steel railings, handrails and guardrails, interior and exterior.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for sleeves, anchors, inserts, plates and similar items.
 - 2. Section 050800 - GALVANIZING AND METAL FINISHES for painted, galvanized finish.
 - 3. Section 055000 - METAL FABRICATIONS for metal treads and nosings not installed in metal stairs.
 - 4. Section 099000 - PAINTING AND COATING for field painting work of this section.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design stairs and railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load and Concentrated Loads: As required by Code.
 - 2. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 3. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.
- C. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses within limits and under conditions indicated.

- D. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to Code.

1.4 SUBMITTALS

- A. Product Data: For each product.
 - 1. Manufacturer's product lines of railings assembled from standard components.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
 - 2. Shop drawings shall be signed and sealed by a professional engineer currently licensed in the State of Maine.
- C. Delegated-Design Submittal: For stairs and railings indicated to comply with performance requirements and design criteria, including structural 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 stairs and railings that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Fabricator of products.
- D. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
 - 1. Stairs: Commercial class.
- E. 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."

1.6 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 stairs. 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 locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. 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.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).
- 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. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.
- E. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.
- F. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209/B 209M, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221/221M, Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

- D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099000 - PAINTING AND COATING.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Provide interior, field-applied primer with a VOC content of 250 g/L or less.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 - 1. Provide interior, field-applied primer with a VOC content of 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: Sika; SikaGrout 212, or approved equal.
 - 2. VOC Content: 0 g/L.
- G. Concrete Materials and Properties: Comply with requirements in Section 033000 - CAST-IN-PLACE CONCRETE for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding, unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
 - 3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

- B. Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. 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.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously, unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- G. 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.
- H. Comply with “Guideline 1: Joint Finishes”, by National Ornamental & Miscellaneous Metals Association (NOMMA), as follows:
 - 1. Typical Railing: Type 2 or better, unless otherwise indicated.
 - 2. Service Stair Railing: Type 3 or better, unless otherwise indicated.
 - 3. Ornamental Railing: Type 1.
- I. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 CAST ALUMINUM STAIR TREADS AND RISERS

- A. Basis of Design: American Safety Tread; Alumacast 805-SR.
 - 1. Form risers, treads, and sub-platforms to configurations shown from cast aluminum; thickness needed to comply with performance requirements.
 - 2. Provide cast aluminum treads and risers in configurations shown of thickness needed to comply with performance requirements, but not less than 1/4-inch with silicon carbide granules embedded in tread surface.

2.8 DETECTABLE WARNING PLATES

- A. Provide galvanized steel or polymer composite detectable warning plates at platform edges as indicated on Drawings.
- B. Comply with requirements of ADA 2010, Section 705 Detectable Warnings, and Department of Transportation Americans with Disabilities Act (ADA) Standards for Transportation Facilities 2006.
- C. Paint Color: As selected by Architect.

2.9 STEEL RAILINGS

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
- C. Form changes in direction of railings as detailed on the Drawings.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 1. Connect posts to stair framing by direct welding, unless otherwise indicated.
 - 2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 - 3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.10 FINISHES

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

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123/A 123M, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
 - 3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 4. Handrails: Galvanizing shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of the railings.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
 - 1. Exterior Stairs (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interior Stairs (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

2.12 HOT-DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

- A. See Section 050800 - GALVANIZING AND METAL FINISHES.

2.13 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coat complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for cross laminated timber, concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. 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.
- F. 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.

3.2 INSTALLING STEEL RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:
 - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 057500
DECORATIVE FORMED METAL

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. Beam wraps.
2. Soffit panels.
3. Metal base.
4. Custom brake metal light fixture covers.
5. Conduit covers.

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

1. Section 055000 - METAL FABRICATIONS for non-ornamental metal fabrications and soffit supports.
2. Section 057300 - DECORATIVE METAL RAILINGS for ornamental metal railings.
3. Section 076100 - SHEET METAL ROOFING for items made of formed metal for roofing and for items made of formed metal for parapets and copings
4. Section 076200 - SHEET METAL FLASHING AND TRIM for items made of formed metal for flashings.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Loads: Capable of withstanding the following structural loads without exceeding the allowable design working stress of materials involved, including anchors and connections, and without exhibiting permanent deformation in any components:

1. Wind Loads on Exterior Items: As indicated on Drawings.

- B. Thermal Movements: Provide exterior ornamental formed-metal assemblies 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 joint sealants, 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, ambient; 180 deg F, material surfaces.

- C. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including finishes.
- B. Shop Drawings: Show fabrication and installation details for formed metal fabrications.
 - 1. Include plans, elevations, sections, and details of formed metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer licensed in the jurisdiction where Project is located responsible for their preparation.
 - 4. Where fabrications are to receive sprayed-on fireproofing, include statement that primer is compatible with fireproofing proposed for use.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, including mechanical finishes, and patterns available for each type of ornamental formed-metal product indicated.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square samples of metal of same thickness and material indicated for the Work.
- E. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing ornamental formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - 1. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.
- C. Source Limitations: Obtain each ornamental formed-metal item through one source from a single manufacturer.
- 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. Provide Mock-Up of custom brake metal light fixture covers.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code - Aluminum."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ornamental formed-metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.
- B. Store products on elevated platforms in a dry location.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with ornamental formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate installation of anchorages for ornamental formed-metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Coordinate installation of ornamental formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy 5005-H32.

2.2 MISCELLANEOUS MATERIALS

- A. Gaskets: As required to seal joints in ornamental formed metal and remain weathertight; and as recommended in writing by ornamental formed-metal manufacturer.
 1. ASTM D 1056, Type 1, Class A, grade as recommended by gasket manufacturer to obtain seal for application indicated.
 2. Closed cell polyurethane foam, adhesive on two sides, release paper protected.
- B. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.
- C. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.
1. Provide concealed fasteners for interconnecting ornamental formed-metal items and for attaching them to other work.
 2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- D. Structural Anchors: For applications indicated to comply with certain design loads, provide anchors fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Nonstructural Anchors: For applications not indicated to comply with design loads, provide anchors of type, size, and material necessary for type of load and installation indicated, as recommended by manufacturer, unless otherwise indicated. Use nonferrous-metal or hot-dip galvanized anchors for exterior installations and elsewhere as needed for corrosion resistance.
- F. Sound-Deadening Materials:
1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
 2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Backing Materials: Provided or recommended by ornamental formed-metal manufacturer.
- H. Laminating Adhesive: Compatible with substrate; noncombustible after curing.
1. Contact Adhesive: VOC content of not more than 80 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 2. Metal-to-Metal Adhesive: VOC content of not more than 30 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 3. Multi-Purpose Construction Adhesive: VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
 4. Special-Purpose Contact Adhesive (contact adhesive used to bond melamine-covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, and rubber or wood veneer, 1/16 inch or less in thickness, to any surface): 250 g/L.
- I. Isolation Coating: Manufacturer's standard bituminous paint.

2.3 PAINTS AND COATINGS

- A. Shop Primers: Provide primers that comply with Section 099000 - PAINTING
- B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI # 79.

- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or 29 and compatible with finish paint systems indicated.
 - 1. Provide interior, field-applied primer with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated; complying with SSPC-Paint 5.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
 - 1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble ornamental formed-metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Coordinate dimensions and attachment methods of ornamental formed-metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.
- C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.
- D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.
 - 1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
- E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce ornamental formed-metal items as needed to attach and support other construction.
- F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install ornamental formed-metal items.
- G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.5 BEAM WRAPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Industrial Louvers, Inc.
 2. Metal Sales & Service, Inc.
 3. MM Systems Corporation.
 4. Southwest Metalsmiths, Inc.
- B. Form beam wraps from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
 1. Aluminum Sheet: Minimum 0.063 inch.
 - a. Finish: High-performance organic coating.
- C. Fabricate with calk stop angle to retain backer rod and sealant.

2.6 SOFFITS

- A. Form soffits from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction, with weathertight joints at exterior installations.
 1. Aluminum Sheet: Minimum 0.063 inch.
 - a. Finish: Match adjacent finish.
 - b. Perforations: As indicated on Drawings.
- B. Conceal fasteners where possible; otherwise, locate where they will be as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.
- C. Drill and tap holes needed for securing closures and trim to other surfaces.

2.7 METAL BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Fry Reglet Corporation.
 2. Pittcon Industries.
- B. Form metal base from metal of type indicated below.
 1. Extruded Aluminum:
 - a. Configuration: As indicated on Drawings.
 - b. Finish: Clear anodic.

2.8 CUSTOM BRAKE METAL LIGHT FIXTURE COVERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Industrial Louvers, Inc.
 - 2. Metal Sales & Service, Inc.
 - 3. MM Systems Corporation.
 - 4. Southwest Metalsmiths, Inc.
- B. Form light fixture covers from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.
 - 1. Aluminum Sheet: Minimum 0.063 inch.
 - a. Finish: High-performance organic coating.
 - 2. Configuration: As indicated on Drawings.

2.9 CONDUIT COVERS

- A. Vertical Covers: Extruded aluminum raceway cover.
 - 1. Finish: To match aluminum framed storefront.
 - 2. Profile: As indicated on Drawings.
 - 3. Basis of Design: Legrand; Wiremold AL5200 Series.
- B. Bridge Base Covers: Backed aluminum panel with aluminum trim.
 - 1. Finish: To match aluminum framed storefront.
 - 2. Panel: 1/4 inch thick panel with 0.040 inch aluminum face and back, and 5 mm ply core.
 - a. Basis of Design: Cap Industries; CAP Metal Panels.
 - 3. Trim: Extruded aluminum trim to cover exposed panel edges.
 - a. Basis of Design: Fry Reglet: Wallcovering Base/Termination.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for steel sheet finishes.
- C. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- E. Apply organic and anodic finishes to formed metal after fabrication, unless otherwise indicated.
- F. Finish items after assembly.

- G. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

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 ornamental formed metal.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate and place ornamental formed-metal items level and plumb and in alignment with adjacent construction.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.
- C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.
- D. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior ornamental formed-metal items weatherproof.
- E. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior ornamental formed-metal items soundproof or lightproof as applicable to the type of fabrication indicated.
- F. Corrosion Protection: Apply nonmelting/nonmigrating-type bituminous coating or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes of ornamental formed-metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

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. Framing with dimension lumber.
 - 2. Wood blocking, cants, and nailers.
 - 3. Plywood backing panels.

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 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. 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.

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack 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. Environmental Product Declarations (EPD): Industry-wide EPDs for wood products are available from the American Wood Council and Canadian Wood Council.

B. 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.

C. 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: AWWPA 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 Azule 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 FRAMING

- 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. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. 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.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.6 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cleveland Steel Specialty Co.
 2. KC Metals Products, Inc.
 3. Phoenix Metal Products, Inc.
 4. Simpson Strong-Tie Co., Inc.
 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 1. Use for wood-preserved-treated lumber and where indicated.
- E. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.
 1. Thickness: 0.062 inch.
- F. I-Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
 1. Thickness: 0.062 inch.
- G. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick.
- H. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.

2.7 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.

2.8 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.

2.9 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.

3.3 WALL AND PARTITION FRAMING INSTALLATION

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-4-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated or required for loads indicated.
 2. For interior partitions and walls, provide 2-by-4-inch nominal-size wood studs spaced 16 inches o.c. unless otherwise indicated or required for loads indicated.
 3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.
- D. Provide diagonal bracing in walls, at locations indicated, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal-size boards, let-in flush with faces of studs.

END OF SECTION

SECTION 061800

GLUED-LAMINATED AND CROSS-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes framing using structural glued-laminated timber, structural cross-laminated timber, and their connections. Some aspects of the specification apply only to glued-laminated timber and some aspects only to cross-laminated timber.
- B. Related Sections:
 - 1. Division 5 Section "Structural Steel" for steel connection elements integral with structural glued-laminated timber construction.
 - 2. Division 06 Section "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.

1.3 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI/APA PRG 320-2017: Standard for Performance-Rated Cross-Laminated Timber.
 - 2. ANSI A190.1-2007 Structural Glued-Laminated Timber.
 - 3. ANSI D3737-05 Structural Glued Laminated Timber
- B. American Society of Mechanical Engineers (ASME)
 - 1. ASME B18.2.1-[2012] Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.
- C. American Society for Testing and Materials International (ASTM)
 - 1. ASTM D2559-12a, Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior (Wet Use) Exposure Conditions.
 - 2. ASTM D7247-17 Standard Test Method for Evaluating the Shear Strength of Adhesive Bonds in Laminated Wood Products at Elevated Temperatures.
- D. National Design Specifications for Wood Construction NDS-2018

1.4 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.
- B. Cross-Laminated Timber (CLT): A prefabricated solid engineering wood panel made of at least three orthogonally bonded layers of solid-sawn lumber or structural composite lumber (SCL) that are laminated by gluing of longitudinal and transverse layers with structural adhesives to form a solid rectangular-shaped, straight, and plane timber intended for roof, floor, or wall applications.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meetings:
 - 1. Convene pre-installation meeting 1 week prior to beginning on-site installation, with Consultant, Contractor's Representative and Departmental Representative to:
 - a. Verify project requirements.
 - b. Review installation and substrate conditions.
 - c. Co-ordination with other building subtrades.
 - d. Review manufacturer's written installation instructions and warranty requirements.
- B. Hold project meetings every month.
- C. Ensure site supervisor, key personnel, project manager, and subcontractor representatives attend.
- D. Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.
- E. Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work.

1.6 PERFORMANCE REQUIREMENTS

- A. Delegated Design: For those structural components noted in the Drawings, design structural glued-laminated timber, cross-laminated timber and connectors, including comprehensive engineering analysis by a qualified professional engineer registered in Maine with 10 years minimum experience of heavy timber connection design, using performance requirements and design criteria indicated.
- B. Structural Performance: Structural glued-laminated timber, cross-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings per NDS and ANSI/AISC 360.
 - 1. Local timber stresses at mechanical connections must be checked, where applicable, per NDS 10.1.2.
 - 2. Details should be avoided where shrinkage of wood can lead to excessive tension

- perpendicular-to-grain stress.
3. Exterior details should be designed to prevent moisture or free water being trapped.
 4. Connections at exposed/unprotected conditions, to be composed of stainless steel, galvanized steel, or otherwise protected from corrosion by a method approved by the architect.
 5. Self-tapping screws may be used in the design of timber connections that meet the requirements in Section 2.3, Timber Connectors. Selection and use of these products remains the responsibility of the delegated design professional engineer. It is the responsibility of the delegated design professional engineer to receive any required approvals for alternate materials and design per IBC 104.11.

1.7 ACTION SUBMITTALS

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

1. Include data on lumber, adhesives, fabrication, and protection. For CLT, provide documentation/data that the product meets the performance requirements in Section 2.2.D & 2.2.E to be used in conjunction with NDS and the CLT Handbook.
2. For connectors, include installation instructions.

B. LEED Submittals:

1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that glulams and cross-laminated timber comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.4: For laminating adhesive used for structural glued-laminated timber and cross-laminated timber, documentation indicating that product contains no urea formaldehyde.

C. Coordination Drawings:

1. The contractor shall prepare and furnish fully coordinated shop drawings showing all ductwork and piping. Separate drawings shall be submitted for ductwork and air handling equipment and for piping. The drawings shall be minimum 3/8" = 1'-0" scale. In addition, the contractor shall coordinate with all other trades and reference on these drawings all major plumbing piping, structural steel, and cross-laminated timber decking, fire protection piping, conduit runs and cable trays by showing these items to scale given above on the shop drawings. A coordinated drawing shall also be submitted and shall include the work of all trades with elevations of all items shown on the drawing as well as locations of walls and partitions, doors, door swings, lighting and all other information required to assure complete coordination among the various trades. Drawings of equipment rooms shall show all bases, pads, inertia blocks, etc. required for mechanical equipment. The contractor shall indicate clearances required for equipment maintenance and service including access for coil and filter removal, etc. Any conflicts which occur with these trades shall be brought to the attention of the Owner's Representative prior to issuance of the Drawings. Refer to Division 1 of the Specifications for additional requirements.
2. CLT contractor shall provide penetrations for pendant mounted lighting fixtures and

- surface mounted fire alarm devices (quantity: 40). CLT contractor to coordinate opening location and sizes with electrical contractor and shall provide coordination drawings prior to submitting CLT shop drawings. Penetration sizes shall be within 1/8" of the fixtures and fire alarms. Provide reinforcing angles for all penetration locations per the drawings.
3. Any field penetrations need to be marked and confirmed by Resident in the field before proceeding. Only CLT contractor can provide penetrations.

D. Shop Drawings:

1. Cross laminated timber:
 - a. Include panel location plans, dimensions, shapes and sections, openings, support conditions, connections.
 - b. Demonstrate exposed lamination of the CLT is of an approved species
 - c. Indicate lifting connections.
 - d. Indicate locations, tolerances, and details of anchorage to supporting structure.
 - e. Include and locate openings larger than 10 inches.
 - f. Indicate location of CLT panel by same identification mark placed on panel.
 - g. Indicate relationship of CLT panels to adjacent materials.
 - h. Clearly indicate stress grade, service grade, appearance grade.
2. Review of shop drawings is of a general nature only, and responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that fabricator has correctly interpreted the contract documents.

E. Samples: Full width and depth, 24 inches (600 mm) long, showing the range of variation to be expected in appearance of structural glued-laminated timber and cross-laminated timber, including variations due to specified treatment.

1. Apply specified factory finish to three sides of half-length of each glulam sample.

F. Delegated-Design Submittal: For structural glued-laminated timber, cross-laminated timber and timber connectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in Maine responsible for their preparation.

1. For timber-to-timber glulam connections, submit proposed connection strategy to the Engineer for approval before submitting glulam beam shop drawings.

1.8 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance:

1. Glued-laminated timber: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in ANSI/AITC A190.1.
2. Cross-laminated timber: Issued by a qualified testing and inspecting agency indicating that structural cross-laminated timber complies with requirements in ANSI/APA PRG-320, or documentation by a qualified testing and inspecting that the product meet or exceeds the requirements of ANSI/APA PRG-320 to the approval of the building official.

- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- C. Research/Evaluation Reports: For structural glued-laminated timber, cross-laminated timber, and timber connectors.

1.9 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Glued-laminated timber: Provide factory-glued structural units produced by an AITC- or APA-licensed firm that is certified for chain of custody by an FSC-accredited certification body.
 - a. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that will not be exposed in the completed Work.
 - 2. Cross-laminated timber: For North American manufactures, provide factory-glued structural units produced by an AITC- or APA-licensed firm. Manufacturers must be able to demonstrate experience with at least 4 CLT projects.
 - a. Manufacturers of CLT:
 - 1) Nordic Engineered Wood
 - 2) Or Approved Equal
- B. Quality Standard:
 - 1. Glued-laminated timber: Comply with ANSI/AITCA 190.1.
 - 2. Cross-laminated timber: Comply with ANSI/APA PRG-320, or documentation by a qualified testing and inspecting that the product meet or exceeds the requirements of ANSI/APA PRG-320 to the approval of the building official.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.
- C. Use all means necessary to protect all glued-laminated and cross-laminated timber members before, during, and after installation to protect the installed work and materials of all other trades.
- D. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Resident at no additional cost to the Owner.
- E. Use non-marring slings for loading, unloading, and handling members to prevent damage to surfaces and/or wrapping. Members that will be exposed to view in the finished building shall be handled using nylon or fabric slings to prevent surface damage.

- F. Store all members off the ground and stacked using separating spacers and prevent staining, cracking, distortion, warping or other physical damage. Ventilate all sides of each manner.
- G. Slit or puncture wrappings on lower side to permit drainage of water.
- H. Wrapping shall not be removed until roof covering has been installed or protection is otherwise provided.
- I. Additional CLT Provisions
 - 1. Any mechanical connectors attached to the CLT panels for installation shall not protrude through to the exposed lamination of the panel. Lift and support units only at designated points shown on Shop Drawings.
 - 2. Handle and transport CLT units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage. Protect corners with wood blocking.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with ANSI/AITC A190.1 and AITC 117, or research/evaluation reports acceptable to authorities having jurisdiction.
 - 1. Provide structural glued-laminated timber made from single species.
 - 2. Provide structural glued-laminated timber made from solid lumber laminations; do not use Structural Composite Lumber.
 - 3. Species of glued-laminated timber and the exposed lamination of the cross-laminated timber must be the same, or a species of timber of similar appearance as approved by the architect. Samples of glued-laminated timber and cross-laminated timber products must be approved by the Resident.
 - 4. Bevel the top of the sloped roof glued-laminated beams in shop to match the sloped roof geometry per the Drawings. Provide additional tension/compression laminations as required to ensure that strength and strength parameters (allowable stresses, modulus of elasticity, etc. in Section 2.1.D.2) for the modified beams are achieved.
- B. Adhesive
 - 1. Provide structural glued-laminated timber made with wet-use adhesive complying with ANSI/AITC A190.1.
 - 2. Adhesive shall not contain urea-formaldehyde resins.
 - 3. VOC limit VOC limit: 50 g/L maximum [to SCAQMD Rule 1168].
- C. Certified Wood: Glued-laminated timber shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- D. Species and Grades for Floor and Roof Beams:

1. Species: Any species that matches the exposed lamination of the cross-laminated timber, or a species of timber of similar appearance as approved by the architect.
 2. Stress Class: 24F-E4 (balanced), or any Stress Class with the following minimum performance values under normal load duration, dry service conditions, and without any NDS design value adjustment factors:
 - a. Bending about the X-X Axis (Loaded Perpendicular to Wide Faces of Laminations)
 - 1) Extreme Fiber in Bending, F_{bx+} and $F_{by-} = 2,400$ psi
 - 2) Compression Perpendicular to Grain, $F_{cpx} = 805$ psi
 - 3) Shear Parallel to Grain (Horizontal), $F_{vx} = 300$ psi
 - 4) Modulus of Elasticity, $E_x = 1,800,000$ psi
 - 5) Modulus of Elasticity for Beam and Column Stability, $E_{x,min} = 930,000$ psi
 - b. Bending about the Y-Y Axis (Loaded Parallel to Wide Faces of Laminations)
 - 1) Extreme Fiber in Bending, $F_{by} = 1,450$ psi
 - 2) Compression Perpendicular to Grain, $F_{cpy} = 650$ psi
 - 3) Shear Parallel to Grain (Horizontal), $F_{vy} = 260$ psi
 - 4) Modulus of Elasticity, $E_y = 1,700,000$ psi
 - 5) Modulus of Elasticity for Beam and Column Stability, $E_{y,min} = 830,000$ psi
 - c. Axially Loaded
 - 1) Tension Parallel to Grain, $F_t = 1,500$ psi
 - 2) Compression Parallel to Grain, $F_c = 1,600$ psi
 - 3) Modulus of Elasticity, $E_{axial} = 1,700,000$ psi
 - d. Fasteners
 - 1) Minimum Specific Gravity for Fastener Design, $G = 0.42$
 3. Lay-up: Balanced. Reference 2.1.A.4 for additional requirements for beveled beams.
 4. Dimensions: Per the Drawings.
 5. Moisture: 15% maximum
 6. Service Conditions:
 - a. Dry service condition for interior beams.
 - b. Exterior portions of glulam beam cantilevers protected by the roof to be sealed and protected to maintain dry service conditions.
- E. Appearance Grade: Architectural, complying with ANSI/AITC A190.1.
1. For Premium and Architectural appearance grades, fill voids as required by ANSI/AITC A190.1.
- F. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- G. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- H. End joints spaced as per bending members unless drawings indicate another requirement.
- I. Edge joints need not be pre-glued.
- J. Camber beams as indicated on the Drawings.

- K. Perform as much cutting and drilling in the shop as is practical.
- L. Mark glued-laminated and/or cross laminated members for identification during erection. Marks shall not be visible in final assembly. The top surface of each member shall be clearly indicated and all glued-laminated wood beams shall bear the quality mark of the American Institute of Timber Construction (AITC) or APA-The Engineered Wood Association (APA) for the grade specified.
- M. All glulam beams to be prepared and installed with the natural camber facing up.

2.2 STRUCTURAL CROSS-LAMINATED TIMBER

- A. General: Provide structural cross-laminated timber that complies with ANSI/APA PRG-320, or research/evaluation reports acceptable to prove cross-laminated timber meets or exceeds ANSI/APA PRG-320 to authorities having jurisdiction.
 - 1. Provide structural cross-laminated timber made from solid lumber laminations; do not use Structural Composite Lumber.
 - 2. Species of glued-laminated timber and the exposed lamination of the cross-laminated timber must be the same, or a species of timber of similar appearance as approved by the architect. Samples of glued-laminated timber and cross-laminated timber products must be approved by the Resident.
- B. Adhesive
 - 1. Provide structural cross-laminated timber made with wet-use adhesive complying with ANSI/APA PRG-320, or research/evaluation reports acceptable to prove adhesive meets or exceeds ANSI/APA PRG-320 to authorities having jurisdiction.
 - 2. Adhesive shall not contain urea-formaldehyde resins.
- C. Certified Wood: Cross-laminated timber shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- D. Species and Grades for CLT Roof Deck, Floor Deck, and Walls:
 - 1. Species: Any species for the non-exposed laminations. For exposed laminations, provide any species that matches the glued-laminated beams, or a species of timber of similar appearance as approved by the architect.
 - 2. The following products are permitted:
 - a. Nordic X-Lam 175-5s, Stress Grade E1, Interior Service Grade, Architectural Appearance Grade
 - b. Or Approved Equal, meeting the performance specifications in Sections 2.2.D.3. to 2.2.D.6.
 - 3. Stress Classes: The following stress classes are permitted.

- a. CLT Grade E1 per ANSI/APA PRG-320
 - b. Any custom CLT grade meeting the requirements of ANSI/APA PRG-320 with the following minimum performance design values under normal load duration, dry service conditions, and without any NDS design value adjustment factors. These values are based on use with NDS and the US CLT Handbook. For CLT grades that are not certified to ANSI/APA PRG-320, the manufacturer must demonstrate that the product meets or exceeds the requirements of ANSI/APA PRG-320 with research and/or product reports published by an independent certification agency acceptable to the authority having jurisdiction.
 - 1) Bending about the Major Strength Direction (longitudinal axis)
 - a) Allowable design moment per foot, $F_b\text{Seff},0 = 10,400 \text{ lbf-ft/ft}$
 - b) Allowable shear per foot, $V_0 = 2,480 \text{ lbf/ft}$
 - c) Flexural Rigidity per foot, $E\text{Ieff},0 = 440 \times 10^6 \text{ lbf-in}^2/\text{ft}$
 - d) Shear Rigidity per foot, $G\text{Aeff},0 = 0.92 \times 10^6 \text{ lbf/ft}$
 - 2) Bending about the Minor Strength Direction (transverse axis)
 - a) Allowable design moment per foot, $F_b\text{Seff},90 = 1,370 \text{ lbf-ft/ft}$
 - b) Allowable shear per foot, $V_{90} = 1,490 \text{ lbf/ft}$
 - c) Flexural Rigidity per foot, $E\text{Ieff},90 = 81 \times 10^6 \text{ lbf-in}^2/\text{ft}$
 - d) Shear Rigidity per foot, $G\text{Aeff},90 = 1.2 \times 10^6 \text{ lbf/ft}$
 - 3) Compression Perpendicular to Grain for Bearing = 425psi
 - 4) Loading In-plane (for Diaphragm Design)
 - a) Allowable In-Plane Shear Strength per foot = 1,490 lbf/ft
 - b) Allowable Compression in Major Direction per foot, $P_0 = 89,000 \text{ lbf/ft}$
 - c) Allowable Tension in Major Direction per foot, $T_0 = 68,000 \text{ lbf/ft}$
 - d) Allowable Compression in Minor Direction per foot, $P_{90} = 21,000 \text{ lbf/ft}$
 - e) Allowable Tension in Minor Direction per foot, $T_{90} = 8,250 \text{ lbf/ft}$
 - 5) Minimum Specific Gravity for Fastener Design, $G = 0.42$
 - 4. Dimensions: Five-ply cross-laminated timber product with a depth of 6.875in (175mm). Use multiple layers of 1.375 in (35mm) thick laminations.
 - 5. Moisture: 12% +/- 2%
 - 6. Service Conditions:
 - a. Dry service condition for interior panels.
 - b. Exterior portions of panels protected by the roof overhang to be sealed and protected to maintain dry service conditions.
 - c. Unprotected exterior applications require approval of the manufacturer.
 - 7. Appearance Grade: Architectural, complying with ANSI/APA PRG-320 Appendix A.A1, or other approved visual/exposed grade by the architect.
- E. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- F. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
- G. Perform as much cutting and drilling in the shop as is practical, including any openings for piping, electrical conduit, and any other building service equipment. Contractor to coordinate and locate all openings on the shop-drawings for approval prior to fabrication.

- H. Mark glued-laminated and/or cross-laminated members for identification during erection. Marks shall not be visible in final assembly. The top surface of each member shall be clearly indicated.
- I. Cross Laminated Timber (CLT) members to be fabricated with 1/4" chamfers on long sides.
- J. CLT panels to be joined by connections designed by a professional engineer registered in Maine for the forces shown in the Drawings.
- K. Coat all cuts, holes and slots.
- L. Field apply sealer to all sides of laminated members. Double coat ends of laminated members.
- M. All structural steel connecting CLT panel elements to each other shall be detailed, and if supplied, test fitted in the shop by the CLT supplier.
- N. General contractor responsible to coordinate tolerance requirements for fabrication and installation amongst all trades.

2.3 TIMBER CONNECTORS

- A. General: Unless otherwise indicated, fabricate from the following materials:
 1. Structural-steel shapes, plates, and flat bars complying with ASTM A 36/A 36M, ASTM A529 Grade 50, or ASTM A572 Grade 50.
 2. Round steel bars complying with ASTM A 575, Grade M 1020.
 3. Hot-rolled steel sheet complying with ASTM A 1011/A 1011M, Structural Steel, Type SS, Grade 33.
 4. Stainless-steel plate and flat bars complying with ASTM A 666, Type 304 or Type 316.
 5. Stainless-steel bars and shapes complying with ASTM A 276, Type 304 or Type 316.
 6. Stainless-steel sheet complying with ASTM A 666, Type 304 or Type 316.
- B. Fabricate strap ties from galvanized steel, 3 inches (75 mm) wide by 0.239 inch (6 mm) thick.
- C. Provide bolts, 3/4 inch (19 mm) unless otherwise indicated, complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); nuts complying with ASTM A 563 (ASTM A 563M); and flat washers.
- D. Provide shear plates, 2-5/8 inches (66.7 mm) or 4 inches (102 mm) in diameter, complying with ASTM D 5933.
- E. Provide lag screws complying with ASME B18.2.1
- F. Provide nails and spikes complying with ASTM F1667
- G. Provide wood screws complying to ASME B18.2.1

- H. Provide self-tapping screws
 - 1. Self-tapping (or self-drilling) screws are high-strength steel or stainless steel screws which are self-drilling (reducing or eliminating the need for pre-drilling) to transfer tension and shear loads between timber-to-timber or timber-to-steel elements. Screw may be fully threaded or only partially threaded.
 - 2. Supporting data and evidence shall consist of valid research reports from approved independent sources to the approval of the building official, to validate that the connection is being used appropriately for the condition and loads.
 - 3. Self-tapping screws are to be installed per manufacturer's instructions.
 - 4. The self-tapping screws must be demonstrated to have been used on at least 20 built projects of a similar, or larger scale.
 - 5. Self-tapping screws shall not be exposed at exterior conditions, unless approved for use by the manufacturer.
 - 6. Self-tapping screw manufacturers:
 - a. SWG(Wurth) - ASSY® series
 - b. SFS Intec – WT,WFC,WFR or WFD series
 - c. GRK Fasteners – R4™ Multi Purpose Screw or RSS Structural
 - d. Simpson Strong Tie – SDS series
 - e. FastenMaster - TimberLOK® series
 - f. HECO – TOPIX or TOPIX-CC series
 - g. Approved Equal

- I. Finish interior non-visible mild steel assemblies and fasteners with rust-inhibitive primer, 2-mil (0.05-mm) dry film thickness. Finish interior exposed mild steel assemblies and fasteners per the Division 05 “Structural Steel.”

- J. For non-visible exterior mild steel assemblies and fasteners, hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A 123/A 123M or ASTM A 153/A 153M. For visible exterior mild steel assemblies, color galvanize per Division 05 “Structural Steel.”

- K. Re-tighten all accessible bolts at the end of the project.

2.4 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
 - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.

- B. All members to be fabricated in accordance with specifications and approved shop drawings.

- C. All members to be suitably marked for identification

- D. Splicing and jointing in locations other than shown in the drawings shall not be permitted.

- E. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less

than 10 minutes.

- F. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

2.5 FACTORY FINISHING

1. Clear Finish: Apply number coats as recommended by manufacturer.
2. Finish to provide both waterproofing and UV protection.
3. Acceptable Products and Manufacturers
 - a. Poly Whey, Vermont Natural Coatings
 - b. Cetol 123 System, Sikkens (Cetol 1 RE basecoat with Cetol 12 Plus topcoat)
 - c. Sanskin
 - d. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of structural glued-laminated timber.
- B. Prior to site erection, examine all site conditions relating to this section of work to ensure that they are acceptable for a satisfactory installation. Report any discrepancies to the architect and manufacturer.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. In the event of discrepancy, immediately notify the Architect.

3.2 INSTALLATION

- A. General: Erect structural glued-laminated and cross-laminated timber true and plumb, and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 1. Lift with padded slings and protect corners with wood blocking.
 2. Install structural glued-laminated timber and cross-laminated timber to comply with Shop Drawings.
 3. Install timber connectors as indicated.
 4. Make adequate provision for possible erection stresses.
 5. Use only that equipment which is of the proper design and capacity and only such personnel as are thoroughly skilled in such work and are completely familiar with the planned method of erection.

6. Properly and adequately shore and brace all glued-laminated beams and cross-laminated timber panels; leave all shoring and bracing in place until the following work, and all other work necessary to provide stability for the roof structure, is complete:
 - a. All framing members in place and all fasteners tightened as required for the completed structure;
 - b. All roof decking and sheathing in place and completely nailed.
 - c. All roof and braced frame connections complete, including drag struts
 - d. Concrete slab-on-grade has been fully poured, including at columns and braced frames, and reached design strength
 - e. Construction loads supported by shoring has been removed.

- B. Cutting: Members shall fit together properly, without trimming, cutting or any other unauthorized modifications. Report any discrepancies to the architect and the manufacturer. Where field fitting is unavoidable, comply with requirements for shop fabrication.

- C. Site cutting or boring of CLT panels, other than shown on shop drawings not permitted without written consent of Engineer and manufacturer.

- D. All joints shall be true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.

- E. Do not shim glued-laminated members.

- F. Bearings:
 1. Make all bearing full unless otherwise indicated on the Drawings
 2. Finish all bearing surfaces on which structural members are to rest so as to give sure and even support; where framing members slope, cut the ends as required to give a uniform bearing surface.

- G. Re-tighten all accessible bolts at the end of the project.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber and cross-laminated timber panels if repairs are not approved by Architect.

3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose including protection from weather, sunlight, soiling, and damage from work of other trades.
 1. Coordinate wrapping removal with finishing work specified in Division 09. Retain wrapping where it can serve as a painting shield.
 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

3.5 FIELD QUALITY CONTROL

- A. General:
 - 1. Notify Resident and Testing Laboratory at least 48 hours prior to start of Work requiring inspection
 - 2. As a minimum, all testing and inspection shall be per this specification and the Maine Uniform Building and Energy Code-Commercial Building Code of Maine.

- B. The following are subject to special inspection:
 - 1. Verify that details have been properly implemented through visual inspection and periodic checking snug-tightness of lag screws of the following timber-to-timber and timber-to-steel connections:
 - a. CLT panel-to-panel and panel-to-glulam connections
 - b. Connection of roof strapping on CLT panels
 - c. Connection of braced frame horizontal members to CLT panels
 - d. Drag strut connections to CLT and steel columns

3.6 CLEAN UP

- A. Remove all wood, including form lumber, scrap lumber, shavings and sawdust, in contact with the ground. Leave no wood buried in any fill or backfill

- B. Clean exposed surfaces of CLT panels after erection and completion of field touch up.
 - 1. Perform cleaning procedures, if necessary, according to CLT manufacturer's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed CLT panels or damage adjacent materials.

- C. Waste Management and Hazmat Disposal:
 - 1. Never incinerate wood containing any chemical preservative treatments in open fires. Wood products containing Chromated Copper Arsenate (CCA) based treatments are not to be incinerated under any circumstances. These woods may only be burned in incinerators approved by the EPA as per RCRA. Set aside any sawn lumber or engineered woods treated with chromium or arsenic (such as CCA and "Wolmanized") for disposal at a municipal landfill. Chromium and arsenic are hazardous materials and as such cannot be disposed of at C&D landfills. Municipal landfills are lined; they are designed to sequester toxins. C&D landfills are not lined and therefore cannot retain the hazardous leachates associated with these treatments.
 - 2. The following restrictions apply when disposing of wood by means of burning.
 - a. Do not burn scrap at the project site
 - b. Do not burn lumber that is less than a year old.
 - c. Never incinerate engineered woods, or treated woods in open fires. They may only be burned in incinerators approved by the EPA as per RCRA. Chromated Copper Arsenate (CCA) treated woods are not to be incinerated under any circumstances.

3. Separate corrugated cardboard used for shipping wood products and place in designated areas for recycling according to the Waste Management Plan.
- D. Separate wood waste and place in designated areas in the following categories for recycling according to the Waste Management Plan.

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. Custom fabricated glue-laminated timber benches.
 2. 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.

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.
- 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.

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/WT'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.
- E. 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 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. Environmental Product Declarations (EPD): Industry-wide EPDs for wood products and plastic laminates are available from the American Wood Council and Canadian Wood Council.
- C. Glue-Laminated Timber: Comply with requirements of Section 061800 – GLUE-LAMINATED AND CROSS-LAMINATED TIMBER CONSTRUCTION.
- D. Concrete Bases: Comply with requirements of Section 033000 – CAST-IN-PLACE CONCRETE and Section 033300 – ARCHITECTURAL CONCRETE.
- E. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304 at interior, Type 316L at exterior.
- G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304 at interior, Type 316L at exterior.

2.2 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.

2.3 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. 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.
- C. 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.
- D. 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.
- E. 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.

2.4 CUSTOM FABRICATED GLUE-LAMINATED BENCHES

- A. Grade: Custom.
- B. Wood Species and Cut: To match materials specified in Section 061800 – GLUE-LAMINATED AND CROSS-LAMINATED TIMBER CONSTRUCTION.
- C. Configuration: As indicated on Drawings.

2.5 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. Transparent Finish: Comply with requirements for finishing specified in Section 061800 – GLUE-LAMINATED AND CROSS-LAMINATED TIMBER CONSTRUCTION.

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. 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 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. Accessories.
 - 3. 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 061060 - MISCELLANEOUS ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

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 AWT'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. Mockup to include one full panel.
 2. 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 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for 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 fitches and solids sources to the greatest extent possible.
- C. Wood Species and Cut for Transparent Finish: Spruce, two sided visual architectural grade.

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. 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.

E. 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.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and that comply with requirements in this Article 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 AWWA C20 (lumber) and AWWA C27 (plywood). Use the following treatment type:
1. Exterior Type: Organic-resin-based formulation thermally set in wood by kiln drying.
 2. Interior Type A: Low-hygroscopic formulation.
 3. Mill lumber after treatment, within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
 4. 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.
 5. 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. Arauco NA; Duraflake FR.
 2. Or approved equal.
 3. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.
 4. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, 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 200 or less per ASTM E 84.
1. Roseburg.; Medite FR.
 2. Or approved equal.

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 TRANSPARENT FINISH

- A. Basis of Design: Elements Modern Timber Buildings; NanoCLT, three layer panels to match cross laminated timber.
- B. Grade: Custom.

- C. Wood Species and Cut: As indicated on the Finish Schedule.
- D. Thickness: 19 mm.
- E. Shop fabricate board paneling in lengths to provide pieces that are uninterrupted by joints. Machine edges of boards to provide joint profiles indicated.
- F. 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 ACCESSORIES

- A. 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.
 - 4. Profile, Basis of Design: Fry Reglet; Millwork Channel L Angle with Return Key.

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.
 - 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.
- C. 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. To match finish of cross laminated timber.

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 071100
BITUMINOUS DAMPPROOFING

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. Cold-applied, emulsified-asphalt dampproofing applied to the following surfaces:
 - a. Exterior, below-grade surfaces of concrete and masonry foundation walls without occupied space at interior, and not indicated to receive waterproofing.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer recommendations for method of application, primer, number of coats, coverage or thickness, and protection course. Indicate special procedures and perimeter conditions requiring special attention.
- B. Material Certificates: For each product, signed by manufacturers.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

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. Euclid Chemical Company.
 2. Henry Company.
 3. Karnak Corporation.
 4. Meadows, W. R., Inc.
 5. Sonneborn, Degussa Building Products.
 6. Tremco Inc.

2.2 BITUMINOUS DAMPPROOFING

- A. Cold-Applied, Emulsified-Asphalt Dampproofing, Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Mastics and related materials as recommended by manufacturer.
- D. Patching Compound: Manufacturer's fibered mastic of type recommended by dampproofing manufacturer.
- E. Protection Course: Multi-ply semi-rigid core composed of a mineral-fortified asphalt core formed between two outside layers of asphalt impregnated reinforced mats, manufactured in accordance with ASTM D 6506, 1/8 inch thick biodegradable hardboard.
- F. Drainage Board: Two-part prefabricated composite drain consisting of formed polystyrene or PVC dimpled core covered on one side with a polypropylene filter fabric, 1/4 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
 2. Verify substrate surfaces are durable and free of matter detrimental to adhesion or application of dampproofing system.

3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply manufacturer approved patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
 - 1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
 - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
 - 3. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
 - 4. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 5. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat required for embedding fabric is in addition to other coats required.
- B. On Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.

3.4 INSTALLATION OF PROTECTION COURSE

- A. Install protection course over completed-and-cured dampproofing. Butt joints of adjacent panels and adhere with mastic. Comply with dampproofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated. Place drainage panel directly over dampproofing, butt joints, place to encourage drainage downwards.
- B. Scribe and cut boards around projections, penetrations, and interruptions.

3.5 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION

SECTION 072100
THERMAL 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 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. Rigid insulation under slabs-on-grade and at perimeter foundation walls.
- 2. Glass-fiber blanket insulation.
- 3. Mineral-wool blanket insulation.
- 4. Roof insulation.

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

- 1. Section 033000 - CAST-IN-PLACE CONCRETE for underslab vapor barrier.
- 2. Section 072700 - AIR BARRIERS for air and vapor barrier membrane.
- 3. Section 092110 - GYPSUM BOARD ASSEMBLIES for acoustic insulation in gypsum board assemblies.
- 4. Division 22 - PLUMBING for plumbing insulation.
- 5. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING for mechanical insulation.

1.3 SUBMITTALS

- A. Product Data: Manufacturer product data, installation instructions, performance criteria, and product limitations for each type of product indicated.
- B. Qualification Data: For Testing Agency.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation 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. Testing Agency Qualifications: An independent agency qualified as a “Certified Infrared Thermographer” per ASNT SNT-TC-1A guidelines, Level I certification minimum.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store in a dry and secure location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver materials to Project site before installation time.
 - 3. Complete installation and concealment of materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 FOUNDATION WALL AND UNDER SLAB INSULATION

- 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. DuPont (formerly Dow Chemical); Reduced GWP Styrofoam series (gray color).
 - 2. Sika Corporation; Sarnatherm XPS
 - 3. Owens Corning; Foamular NGX (Next Generation Extruded) series.
- B. Extruded-Polystyrene (XPS) Board Insulation: ASTM C 578, square edged of type, density, and compressive strength indicated below:
 - 1. For vertical applications, Type IV, 1.6-lb/cu. ft. minimum density and 25-psi minimum compressive strength.
 - 2. For horizontal applications, pedestrian traffic, Type VII, 2.2-lb/cu. ft. minimum density and 60-psi minimum compressive strength.
 - 3. For horizontal applications, vehicular traffic, Type V, 3-lb/cu. ft. minimum density and 100-psi minimum compressive strength.
 - 4. Thermal Resistivity (R-value): 5.0 per inch.
 - 5. Blowing Agent: Honeywell; Solstice Liquid Blowing Agent, low global warming potential (GWP) hydrofluoro-olefin (HFO), or approved equal.
 - a. Other insulation manufacturers may be considered, if they have adopted the HFO blowing agents by start of construction.
 - 6. Recycled Content: 20 percent min.
- C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.2 BLANKET INSULATION, GLASS FIBER BLANKET

- 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. CertainTeed Corporation.
 2. Johns Manville.
 3. Knauf Insulation.
 4. Owens Corning.
- B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. GreenGuard certified as formaldehyde free and low chemical emissions.
- C. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier). GreenGuard certified as formaldehyde free and low chemical emissions.
- D. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier). GreenGuard certified as formaldehyde free and low chemical emissions.
- E. Glass-Fiber Blanket, Foil Faced: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. GreenGuard certified as formaldehyde free and low chemical emissions.

2.3 BLANKET INSULATION, MINERAL-WOOL BLANKET

- 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. Owens Corning; Thermafiber UltraBatt FF.
 2. Isolatek International.
 3. Rockwool (formerly Roxul).
- B. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Recycled Content: 70 percent min.
 2. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
 3. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification, formaldehyde-free.
- C. Mineral-Wool Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less per ASTM E 84); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene. GreenGuard certified as formaldehyde free and low chemical emissions.

2.4 SPRAYED-FOAM INSULATION, AT GAPS AND VOIDS

- 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. Dow Chemical; GreatStuff Pro.
 - 2. ICP Adhesives and Sealants (formerly Fomo Products): Handi-Foam products.
 - 3. Approved equal.
- B. Sprayed-Foam Insulation: Water-cure closed cell polyurethane containing no urea-formaldehyde and no CFCs.
 - 1. Minimum density of 0.4 lb/cu. ft., thermal resistivity of 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 2. Fire Resistance: UL 723, Flame Spread 25 max., and Smoke Developed 50 max.
 - 3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Industry-wide EPD.
 - 4. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.5 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Atlas Roofing Corporation.
 - b. Carlisle SynTec Incorporated.
 - c. Firestone Building Products Company.
 - d. GAF Materials Corp.
 - e. GenFlex Roofing Systems.
 - f. Johns Manville International Inc.
 - 2. Compressive Strength at Terraces: In accordance with ASCE 7-05, "Minimum Design Load for Building and other Structures", pedestrian terraces are required to support a minimum live load of 100 psf. Use 40 psi insulation for when pavers are on pedestals and exclusive of planters and other heavy concentrated loads such as heavy wheel traffic.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.
- E. Cover Board: Provide the following, as required by roofing manufacturer to comply with performance requirements and provide specified warranty.

1. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 or 5/8 inch thick, factory primed.

2.6 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
 1. Low-Emitting Materials: Provide interior 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. Do not use adhesives that contain urea formaldehyde.
 3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives.
- B. Masonry and Concrete Fasteners:
 1. Hardened nails, pneumatically-driven fasteners or other anchors recommended by insulation manufacturer, sufficient to penetrate substrate and permanently retain insulation.
 2. Self-adhering insulation stick pins: Galvanized steel plate welded to projecting steel spindle; capable of holding insulation thicknesses indicated securely in position indicated with self-locking galvanized steel washer in place. Backseal fastener penetrations.
- C. Tape: Adhesive tape recommended by insulation manufacturer, to tape joints and tears in faced insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Miscellaneous Voids: Install spray polyurethane foam insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.
 - 1. Cure insulation with continuous natural or mechanical ventilation.
 - 2. Remove and dispose of over-spray.

3.4 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set rigid insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay rigid insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

3.6 ROOF INSULATION AND COVERBOARD INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
 - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
- G. Adhered Cover Boards: Install cover boards over mechanically-fastened insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Adhere cover boards to mechanically-fastened insulation in ribbons of bead-applied adhesive or full-spread adhesive, as required to comply with performance and warranty requirements.
 - 1. Locations for Adhered Cover Board Installation: Provide under green roof areas and elsewhere, where indicated.
 - 2. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports.
- B. Infrared Camera Survey: Perform an infrared camera scan of walls, floors, and ceilings to determine where insulation and air barrier are not continuous, after insulation has been installed, but prior to plaster patching or new gypsum board installation.
 - 1. Provide complete digital report with images of test results with recommendations for repairs.
- C. Repair or replace work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 072600
BELOW GRADE VAPOR RETARDER

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. Vapor retarders under slabs-on-grade.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE.

1.3 SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. GCP Applied Technologies (formerly W.R. Grace).
 - 2. Raven Industries Inc.
 - 3. Stego Industries, LLC.

2.2 VAPOR BARRIER

- A. Vapor Barrier shall have the following qualities:

1. Permeance of less than 0.01 perms per ASTM F 1249 or ASTM E 96.
2. ASTM E 1745 Class A.
3. Thickness: 15 mils.
4. Basis-of-Design: Stego Wrap Vapor Barrier by Stego Industries LLC.

B. Accessories:

1. Seam Tape:
 - a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96.
 - b. Basis-of-Design: Stego Tape by Stego Industries LLC.
2. Vapor Proofing Mastic:
 - a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96.
 - b. Basis-of-Design: Stego Mastic by Stego Industries LLC.
3. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.
4. Termination Bar.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.3 INSTALLATION

- A. Install vapor retarder membrane in accordance with ASTM E1643 and manufacturer's instructions.
- B. Unroll vapor retarder membrane with longest dimension parallel to direction of slabs-on-grade concrete pour.
- C. Lap vapor retarder membrane over footings and seal to foundation walls in accordance with manufacturer's recommendations.
- D. Lap vapor retarder membrane joints a minimum of 6 inches and seal with seam tape.
- E. Seal vapor retarder membrane penetrations by applying penetration seal or by constructing boots from vapor retarder membrane and seam tape.

- F. Repair damaged areas by cutting patches of vapor retarder membrane, extending 6 inches, minimum, beyond damaged area. Seal patch perimeter with seam tape.

3.4 PROTECTION

- A. Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 072700
AIR BARRIERS

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. Fluid-applied, vapor-permeable membrane air barrier.
 - 2. Transition strips to adjacent and penetrating materials.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for roof air and vapor barrier.
 - 2. Section 079200 - JOINT SEALANTS for joint sealant requirements.

1.3 DEFINITIONS

- A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall or soffit, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air Barrier Assembly Air Leakage: Not to exceed 0.03 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., ASTM E 2357.

1.5 PRECONSTRUCTION TESTING

- A. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. The Owner may engage a qualified testing agency.
2. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E 783.
3. Notify Architect and the Owner a minimum of seven days in advance of the dates and times when mockup testing will take place.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.
- B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 1. Include details of interfaces with other materials that form part of air barrier.
 2. Include details of mockups.
- C. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with air barrier; signed by product manufacturer.
- D. Qualification Data: For Applicator.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.7 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying air barrier materials 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. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly 150 sq. ft., incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
 1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
 2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 3. If the Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed curtain walls, and door frames.
 - 2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Store rolls according to manufacturer's written instructions.
- D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIERS

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.
 - 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. Carlisle Coatings & Waterproofing; Barritech VP.
 - b. GCP Applied Technologies (formerly W.R. Grace); Perm-A-Barrier VP.
 - c. Henry Co.; Air Bloc STPE, 07, 31MR, or 33MR.
 - 2. Physical and Performance Properties:
 - a. Membrane Air Permeance: Not to exceed 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Membrane Vapor Permeance: Not less than 10 perms; ASTM E 96.

2.2 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.
- C. Counterflashing Strip: Modified bituminous 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, crosslaminated polyethylene film with release liner backing.
- D. Butyl Strip at Termination with EPDM or TPO Roofing Membrane: Vapor-retarding, 30- to 40-mil-thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.
- E. Modified Bituminous Strip To Cover Cracks and Joints and Terminate Air Barrier to Compatible Roofing Membrane: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- polyethylene film with release liner backing.
- F. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.
- G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- J. Sprayed Polyurethane Foam Sealant to Fill Gaps at Penetrations and Openings: one- or two-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- K. Modified Bituminous Transition Strip to Seal Air Barrier Terminations with Glazing Systems: Vapor-retarding, 40-mil-thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene or aluminum film with release liner backing.
- L. Preformed Silicone-Sealant Extrusion to Seal Air Barrier Terminations with Glazing Systems: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
 - 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; 123 Silicone Seal.

- b. Elbex Corp: Transition Silicone Sheeting.
 - c. GE Silicone; UltraSpan US1100.
 - d. Tremco; approved equal.
- M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 - JOINT SEALANTS.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 4. Verify that masonry joints are flush and completely filled with mortar.
 5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- G. Bridge and cover isolation joints expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping modified bituminous strips.
- H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

- I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT IN PREPARATION FOR INSTALLATION OF FLUID-APPLIED MEMBRANE

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install butyl or modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is

achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
 2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
 3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, modified bituminous strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 INSTALLATION OF FLUID-APPLIED MEMBRANE AIR BARRIER

- A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.
- B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.
- C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
1. Vapor-Permeable Membrane Air Barrier: Minimum 20-mil wet film thickness.
- E. Apply strip and transition strip a minimum of 1 inch onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.
- F. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation, and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

- C. Tests:

1. Qualitative Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186.
2. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 783.

- D. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

- A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 30 days.

2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.
- B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 074470
CONCRETE-FACED INSULATED 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. Concrete-faced insulated panels and attachment systems, at building exterior.
- 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 framing, sheathing, furring, grounds, nailers, and blocking.
 - 2. Section 072100 - THERMAL INSULATION for other insulation types.
 - 3. Section 076200 - SHEET METAL FLASHING AND TRIM for copings, flashings, and other sheet metal work not part of wall panel assemblies.
 - 4. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type, color, texture, and pattern required.
 - 1. 6-inch-long-by-actual-width Sample of panel.
 - 2. 6-inch- long-by-actual-width Samples of accessories.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type, color, texture, and pattern of panels, including related accessories, from single source from single manufacturer.
- B. Manufacturer Qualifications: Provides design, engineering, fabrications and testing of all required components and assemblies for a complete system.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with panel installation only if substrate is completely dry and if existing and forecasted weather conditions permit panel to be installed according to manufacturer's written instructions.

1.6 SEQUENCING

- A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete-Faced Perimeter Foundation Insulation: Extruded polystyrene board to ASTM C 578 (CAN/ULC-S701) Type IV, rigid, closed cell, with integral high density skin, c/w integral 5/16 inch (8 mm) thick latex-modified concrete facing.
 - 1. Basis of Design: T Clear Corp.; WALLGUARD Concrete Faced Insulated Perimeter Wall Panels.
 - 2. Board Size: 2 feet by 4 feet by 2-5/16 inches and 3-5/16 inches thick (610 mm by 1219 mm by 59 mm or 84 mm).
 - 3. Edges: Tongue and groove sides, square edge ends.
 - 4. Maximum Use Temperature: 165 degree F (74 degree C).
 - 5. Thermal Resistance (ASTM C 518): Long term aged R-value of 5 per inch (0.03 sm K/W per mm).
 - 6. Foam Compressive Strength, ASTM D 1621, minimum: 35 psi (240 kPa).
 - 7. Compressive Strength: to ASTM D 1621, minimum 40 psi (275.6 kPa)
 - 8. Water Absorption (ASTM D 2842): <0.1 (0.7% by volume maximum).
 - 9. Water Vapor Permeance (ASTM E 96): 0.8 (50 ng/Pas m).
 - 10. Coefficient of Lineal Thermal Expansion (ASTM D 696, in/in• degree F (mm/m• degree C)): 3.5×10^{-5} (6.3×10^{-2}).
- B. Panel Performance Requirements:
 - 1. Wall Panel System Fire Test:
 - a. Meets Uniform Building Code (UBC) 17-5 - Room Fire Test Standard for Interior of Foam Plastic Systems. Criteria are to maintain coverage of foam substrate up to 8 feet (2438 mm) from interior corner, over the duration on the test.
 - b. Equivalent to current UL 17-15 and UBC 97 revised.
 - 2. Negative Wind Load And Gravity Shear Load Tests:
 - a. Concluded that clips spaced at 2 feet (610 mm) along each horizontal joint can safely carry the wall panel vertical weight and support the panel under negative wind pressures of up to 25 psf, with a safety factor of 2.
 - b. If greater wind pressures are anticipated, additional clips may be placed to provide the additional strength.

2.2 ACCESSORIES

- A. Metal Cap Flashing: 24 ga (0.61mm) galvanized steel J-channel; 2-1/4 inches (57mm) wide, 4 inches (102 mm) long leg and 2-1/4 inches (57mm) short leg; prefinished in color as selected.
 - 1. Comply with requirements of Section 076200 - SHEET METAL FLASHING AND TRIM.
- B. Clips and Fasteners: Corrosion-resistant type metals, sized to suit application for substrate indicated; as recommended by insulation manufacturer.

2.3 FABRICATION

- A. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and seal edges with the linseed-based wood stain selected for the exposed face.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of panels and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Do not install damaged components.
 - 2. Install products plumb, level, true, and aligned with adjacent materials.
 - 3. Layout concrete-faced insulation boards to maximize board sizes. Do not use boards less than 6 inches wide.
 - 4. Install concrete-faced insulation board system in orientation as indicated or to maximize full sheets. Complete with fastening clips and cap flashing in accordance with manufacturer's installation guidelines.

- B. Install joint sealants as specified in Section 079200 - JOINT SEALANTS and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 074610
FIBER-CEMENT SIDING

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. Fiber-cement siding and trim.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 076200 - SHEET METAL FLASHING AND TRIM for copings, flashings, and other sheet metal work not part of fiber-cement wall panel assemblies.
 - 2. Section 079200 - JOINT SEALANTS for field-applied sealants not otherwise specified in this Section.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide fiber-cement wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- B. Structural Performance: Provide fiber-cement wall panel assemblies capable of withstanding the effects of gravity loads and loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592 and ASTM E 330 as applicable.
 - 1. Wind Loads: As required by Code.
 - 2. Deflection Limits: Engineer fiber-cement wall panel assemblies to withstand test pressures with deflection no greater than 1/180 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span, at code required loading.
- C. Thermal Movements for Fiber-Cement Wall Panels: Provide fiber-cement wall panel assemblies that allow for noiseless thermal movements resulting from the following range in ambient temperatures and that prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects:
 - 1. Ambient Temperature Range: Minus 20 to plus 180 deg F.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of fiber-cement wall panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of fiber-cement wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Fiber-Cement Panels: 12 inches square. Include fasteners, closures, and other fiber-cement wall panel accessories. Include 4-way joint.
 - 2. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of fiber-cement wall panels adjacent to joint sealants.
- D. Qualifications: Qualifications of professional engineer and qualifications of installer as specified.

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 state the 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 panels that are similar to those indicated for this Project in material, design, and extent.
- C. Source Limitations: Obtain each type, color, texture, and pattern of siding and trim, including related accessories, from single source from single manufacturer.
- D. Installer Qualifications: An employer of workers trained and approved by manufacturer.
 - 1. Installer's responsibilities include fabricating and installing fiber-cement wall panel assemblies and providing professional engineering services needed to assume engineering responsibility.
 - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- E. Fabricator Qualifications: Certified by fiber-cement wall panel manufacturer to fabricate and install manufacturer's wall panel system.
- F. Source Limitations: Obtain each type of fiber-cement wall panel through one source from a single manufacturer.
 - 1. Obtain support system from panel manufacturer.

- G. 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 methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- H. Fire-Resistance Ratings: Where indicated, provide fiber-cement wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- I. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for siding and trim including accessories.
 - a. Size: 48 inches long by 60 inches high.
 - b. Include outside corner on one end of mockup and inside corner on other end.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- J. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to fiber-cement wall panel assemblies including, but not limited to, the following:
1. Meet with The Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, fiber-cement wall panel Installer, fiber-cement wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects fiber-cement wall panels including installers of doors, windows, and louvers.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to fiber-cement wall panel installation, including manufacturer's written instructions.
 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 5. Review flashings, special details, wall penetrations, openings, and condition of other construction that will affect fiber-cement wall panels.
 6. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
 7. Review temporary protection requirements for fiber-cement wall panel assembly during and after installation.
 8. Review fiber-cement wall panel observation and repair procedures after fiber-cement wall panel installation.
 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, fiber-cement wall panels, and other manufactured items so as not to be damaged or deformed. Package fiber-cement wall panels for protection during transportation and handling.
- B. Unload, store, and erect fiber-cement wall panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Store fiber-cement wall panels vertically, covered with suitable weathertight and ventilated covering. Store fiber-cement wall panels to ensure dryness, with positive slope for drainage of water. Do not store fiber-cement wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of fiber-cement wall panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before fiber-cement wall panel fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating fiber-cement wall panels without field measurements, or allow for field trimming of panels. Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate fiber-cement wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

- A. Special Warranty: Standard form in which manufacturer agrees to repair or replace siding and trim that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking, deforming, and fading.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than 5 Hunter color-difference units as measured according to ASTM D 2244.
 - 3. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING AND TRIM

- A. General: Siding made from high-density fiber-cement board that complies with ASTM C 1186, Type A, Grade II; is classified as noncombustible when tested according to ASTM E 136; and has a flame-spread index of 25 or less when tested according to ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: American Fiber Cement; AFC Cladding/Cembrit, Patina and Transparent.
 - b. Equitone Fiber Cement; Natura.
 - c. SwissPearl Fiber Cement; Format Largo, Patina.
 2. Patterns: As indicated on Drawings.
 3. Panel Thickness: 5/16 inch.
 4. Finish:
 - a. Patina: Through-colored, muted, matte finish with a unique weather-proof treatment which makes it resistant to staining and surface dirt.
 - b. Transparent: Through-colored, fiber cement board with a semi-transparent surface treatment.
 - c. Color: Amber-P565.
 5. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
 6. Physical Characteristics: ASTM C1185/C1186, EN 12467:
 - a. Density Dry: Greater than 1475 kg/m³.
 - b. Bending strength at with grain: Minimum 22.0 MPa.
 - c. Bending strength at across grain: Minimum 24.8 MPa.
 - d. Modulus of elasticity at with grain: Greater than 12 GPa.
 - e. Modulus of elasticity at across grain: Greater than 13.8 GPa.
 - f. Durability classification (EN 12467): Category A.
 - g. Strength classification (EN 12467): Class 4.
 - h. Fire reaction (EN 13501-1): A2-s1-d0.
 - i. Warm water test: Ok.
 - j. Soak dry test: Ok.
 - k. Freeze thaw test: greater than 100 cycles.
 - l. Thermal conductivity e: 0.37 - 0.5 W/mK.
 7. Fire Testing:
 - a. ASTM E84
 - b. ASTM E136
 - c. CAN/ULC S102
 - d. CAN/ULC S114
 - e. EN 13501-1

8. Evaluation Report:
 - a. Patina: ESR-3863 Cembrit Fiber-Cement Façade Panel System.
 - b. Transparent: UES- 553 Cembrit Fiber-Cement Façade Panel System.

2.2 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 1. Provide accessories made from same material as adjacent siding unless otherwise indicated.
- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated on the Drawings.
 1. Colors for Decorative Accessories: As selected by Architect from manufacturer's full range of industry colors.
 2. Aluminum Joint Closures and Decorative Corner Profiles: Manufacturer's standard products as detailed. Maximum thickness of finishing profile to be 0.8 mm or 21-gauge.
- C. Flashing: Provide stainless-steel flashing complying with Section 076200 - SHEET METAL FLASHING AND TRIM at window and door heads and where indicated.
- D. Attachment System, Aluminum Supporting Members:
 1. Provide support system recommended by panel manufacturer.
 2. Aluminum "Hat" and "Z" profiles min. 2mm thickness.
 3. UV Protective Membrane: For open joint ventilated rain screen systems.
- E. Fasteners:
 1. For fastening fiber-cement, use stainless-steel fasteners.
 2. For fastening to wood, use siding nails or ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
 3. For fastening PVC trim to wood, use #8 trim screws long enough to penetrate substrate 1-1/4 in.
 4. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
 5. Staples, small brads, and wire nails will not be accepted.

2.3 FABRICATION

- A. General: Fabricate and finish fiber-cement wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Sheet Metal Accessories: Fabricate trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in fiber-cement to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by fiber-cement wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or fiber-cement wall panel manufacturer for application but not less than thickness of metal being secured.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, fiber-cement wall panel supports, and other conditions affecting performance of work.
 1. Examine primary and secondary wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by fiber-cement wall panel manufacturer.
 2. Examine solid wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by fiber-cement wall panel manufacturer.
 3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating fiber-cement wall panels to verify actual locations of penetrations relative to seam locations of fiber-cement wall panels before fiber-cement wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

- C. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and fiber-cement wall panel manufacturer's written recommendations.

3.3 FIBER-CEMENT WALL PANEL INSTALLATION, GENERAL

- A. General: Install fiber-cement wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts, unless otherwise indicated. Anchor fiber-cement wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting of fiber-cement wall panels is not permitted.
 - 2. Shim or otherwise plumb substrates receiving fiber-cement wall panels.
 - 3. Rigidly fasten base end of fiber-cement wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
 - 4. Flash and seal fiber-cement wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by fiber-cement wall panels are installed.
 - 5. Install screw fasteners in predrilled holes.
 - 6. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 7. Install flashing and trim as fiber-cement wall panel work proceeds.
 - 8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 - 10. Align bottom of fiber-cement wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners: Use stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fiber-cement wall panel manufacturer.

3.4 WALL PANEL INSTALLATION

- A. General: Install attachment system required to support wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
 - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
 - 2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.
- B. Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal

joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.

1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.

3.5 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete fiber-cement wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align fiber-cement wall panel units within installed tolerance of 1/4 inch in 20 feet nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

- A. After fiber-cement wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- B. Replace fiber-cement wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 076100
SHEET METAL 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. Custom-fabricated sheet metal roofing:
 - a. Standing-seam metal roofing.
 - b. Accessories.
- 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 076200 - SHEET METAL FLASHING AND TRIM for fasciae, copings, and flashings that are not part of sheet metal roofing.
 3. Section 079200 - JOINT SEALANTS for field-applied sheet metal roofing sealants.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide complete sheet metal roofing system, including, but not limited to, custom-fabricated metal roof pans, cleats, clips, anchors and fasteners, sheet metal flashing and drainage components related to sheet metal roofing, fascia panels, trim, underlayment, and accessories as indicated and as required for a weathertight installation.
- B. Fabricate and install roofing capable of resisting forces required by Code according to recommendations in FMG Loss Prevention Data Sheet 1-49.
- C. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal roofing thermal movements. 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. Water Infiltration: Provide sheet metal roofing that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal roofing lapped to allow moisture to run over and off the material.
- E. Energy Performance: Provide roofing system with Solar Reflectance Index (SRI) not less than the following when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency:
 - 1. Low-sloped roof (less than or equal 2:12) - 82 minimum (initial); 64 (3-year aged).
 - 2. Steep-sloped roof (greater than 2:12) - 39 minimum (initial); 32 (3-year aged).

1.4 SUBMITTALS

- A. Product Data: For each product indicated. Include details of construction relative to materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal roofing, including plans, elevations, and keyed references to termination points. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Details for forming sheet metal roofing, including seams and dimensions.
 - 2. Details for joining and securing sheet metal roofing, including layout of fasteners, clips, and other attachments. Include pattern of seams.
 - 3. Details of termination points and assemblies, including fixed points.
 - 4. Details of expansion joints, including showing direction of expansion and contraction.
 - 5. Details of roof penetrations.
 - 6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counter flashings.
 - 7. Details of special conditions.
 - 8. Details of connections to adjoining work.
 - 9. Details of the following accessory items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Roof curbs.
 - c. Snow guards.
 - d. Gutters and downspouts.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Roofing: 12 inches long by actual pan width, including finished seam. Include fasteners, cleats, closures, and other attachments. Include color selected.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Accessories: 12-inch-long Samples for each type of accessory.
 - a. Snow Guards: Full-size Sample.
- 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.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain all components for roofing system from roofing system manufacturer.
- B. Sheet Metal Roofing Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Copper Roofing Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. 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; Architect, Owner's insurer if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions and details.
 - 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal roofing pans, components, and other sheet metal roofing materials so as not to be damaged or deformed. Package sheet metal roofing materials for protection during transportation and handling.
- B. Unload, store, and erect sheet metal roofing materials in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Store sheet metal roofing materials to ensure dryness. Do not store sheet metal roofing materials in contact with other materials that might cause staining, denting, or other surface damage.

- D. Protect strippable protective covering on sheet metal roofing from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal roofing installation.

1.7 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.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal roofing that shows evidence of deterioration of factory-applied finishes within specified warranty period.

- 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Finish Warranty Period: 20 years from date of Substantial Completion.

- B. Special Installer's Warranty: Roofing Installer's warranty, on warranty form signed by Roofing Installer, in which Roofing Installer agrees to repair or replace components of custom-fabricated sheet metal roofing that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Loose parts.
 - c. Wrinkling or buckling.
 - d. Failure to remain weathertight, including uncontrolled water leakage.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering, including nonuniformity of color or finish.
 - f. Galvanic action between sheet metal roofing and dissimilar materials.

- 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOFING SHEET METALS

- A. Basis of Design: PAC-Clad; Tite-Loc Plus.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

- 1. Thickness: 0.040 inch, unless otherwise indicated.
- 2. Surface: Smooth, flat finish.

3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings: Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil; complying with AAMA 2605.
 - a. Color: Hemlock Green.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 2. Low Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 3. Available Products:
 - a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "HR" High Performance Roofing Underlayment.
 - b. Grace, W. R. & Co.; Vycor Ultra.
 - c. Henry Company; Perma-Seal PE.
 - d. TC MiraDRI; WIP 300HT.
- B. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 1. Exposed Fasteners: Heads matching color of sheet metal roofing by means of plastic caps or factory-applied coating.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 3. Blind Fasteners: Stainless steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- D. Elastomeric Joint Sealant: ASTM C 920, of base polymer, type, grade, class, and use classifications required to produce joints in sheet metal roofing that will remain weathertight and as recommended by roll-formed sheet metal roofing manufacturer for installation indicated.

- E. Expansion-Joint Sealant: For hooked-type expansion joints, which must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.
- F. Bituminous Coating: Cold-applied asphalt mastic, ASTM D 1187, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.4 ACCESSORIES

- A. Sheet Metal Roofing Accessories: Provide components required for a complete sheet metal roofing assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of sheet metal roofing, unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as sheet metal roofing.
 - 2. Clips: Minimum 0.0625-inch-thick, stainless steel panel clips designed to withstand negative-load requirements.
 - 3. Cleats: For mechanically seaming into joints and formed from the following materials:
 - a. Metallic-Coated Steel and Aluminum Roofing: 0.0250-inch- thick stainless steel.
 - b. Copper and Zinc-Tin Alloy-Coated Copper Roofing: 16-oz./sq. ft. copper sheet.
 - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from same material and with same finish as sheet metal roofing, minimum 0.025-inch-thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 - 1. Pipe and Penetration Flashing: Premolded, flashing sleeve or pipe collar with flexible metal ring bonded to sloped base. Intended to provide weatherproof seal and to isolate pipe movement from vibration and expansion/contraction.
- C. Roof Curbs: Fabricated from same material and finish as sheet metal roofing, minimum thickness matching the sheet metal roofing; with bottom of skirt profiled to match roof panel profiles; with weatherproof top box and integral full-length cricket. Fabricate curb sub framing of nominal 0.062-inch- thick, angle-, C-, or Z-shaped galvanized steel or stainless steel sheet. Fabricate curb and sub framing to withstand indicated loads of size and height indicated. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
 - 1. Factory insulate curbs with 1-inch- thick, rigid insulation.
 - 2. Factory install wood nailers at tops of curbs.
 - 3. Fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.
- D. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating sheet metal roofing, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Seam-Mounted, Bar-Type Snow Guards: Aluminum rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam sheet metal roofing.
 - a. Aluminum Finish: Match roofing.
 - b. Available Products:
 - 1) Alpine Snow Guards, Div. of Vermont Slate & Copper Services, Inc.; Model No. 05-98.
 - 2) LMCurbs; S-5! SnoFence.
 - 3) Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard.

- E. Hanging Gutters: Fabricate to cross-section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
 1. Gutter Style: As indicated on Drawings.
 2. Expansion Joints: Lap type.
 3. Gutters with Girth up to 20 Inches: Fabricate from the following materials:
 - a. Aluminum: 0.060 inch thick.
 4. Gutters with Girth greater than 20 Inches: Fabricate from materials and minimum thicknesses recommended by SMACNA.

- F. Downspouts: Fabricate downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Downspout Shape: As indicated on Drawings.
 2. Hanger Style: As indicated on Drawings.
 3. Downspouts: Fabricate from the following materials:
 - a. Aluminum: 0.040 inch thick.

- G. Chain Downspouts or Rain Chains:
 1. Material: Aluminum.
 2. Configuration: As indicated on Drawings.

- H. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout.
 1. Fabricate from the following exposed metal:
 - a. Aluminum: 0.060 inch (1.02 mm) thick.

- I. Splash Blocks: Provide precast concrete splash blocks.

2.5 FABRICATION

- A. General: Custom fabricate sheet metal roofing to comply with details shown and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions (pan width and seam height), geometry, metal thickness, and other characteristics of installation indicated. Fabricate sheet metal roofing and accessories at the shop to greatest extent possible.
 - 1. Standing-Seam Roofing: Form standing-seam pans with finished seam height of 2 inches.
- B. General: Fabricate roll-formed sheet metal roofing panels to comply with details shown and roll-formed sheet metal roofing manufacturer's written instructions.
- C. Fabricate sheet metal roofing to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.
 - 1. Lay out sheet metal roofing so cross seams, when required, are made in direction of flow with higher pans overlapping lower pans. Stagger cross seams.
 - 2. Fold and cleat eaves and transverse seams in the shop.
 - 3. Form and fabricate sheets, seams, strips, cleats, valleys, ridges, edge treatments, integral flashings, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required for leakproof construction.
- D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant (concealed within joints).
 - 1. At Each Side of Bridge: Provide 3 inch wide expansion joints as part of warranted roof system.
- E. Sealant Joints: Where movable, nonexpansion-type joints are indicated or required to produce weathertight seams, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.
- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturers of dissimilar metals or by fabricator.
- G. Sheet Metal Accessories: Custom fabricate flashings and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Obtain field measurements for accurate fit before shop fabrication.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams: Fabricate nonmoving seams with flat-lock seams.

3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

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. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, sheet metal roofing supports, and other conditions affecting performance of work.
 1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances.
 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored, and that provision has been made for flashings, and penetrations through sheet metal roofing.
 3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before sheet metal roofing installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install flashings and other sheet metal to comply with requirements specified in Section 076200 - SHEET METAL FLASHING AND TRIM.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under sheet metal roofing. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply over entire roof in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
- B. Install flashings to cover underlayment to comply with requirements specified in Section 076200 - SHEET METAL FLASHING AND TRIM.
- C. Apply slip-sheet over underlayment before installing sheet metal roofing.

3.4 INSTALLATION, GENERAL

- A. General: Install roofing according to roofing system manufacturer's written instructions. Install sheet metal roofing perpendicular to purlins or supports. Anchor sheet metal roofing and other components of the Work securely in place, with provisions for thermal and structural movement. Install fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for a complete roofing system and as recommended by fabricator for sheet metal roofing.
 - 1. Field cutting of sheet metal roofing by torch is not permitted.
 - 2. Rigidly fasten eave end of sheet metal roofing and allow ridge end free movement due to thermal expansion and contraction. Pre-drill roofing.
 - 3. Provide metal closures at each side of ridge caps.
 - 4. Flash and seal sheet metal roofing with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 6. Install ridge caps as sheet metal roofing work proceeds.
 - 7. Locate roofing splices over, but not attached to, structural supports. Stagger roofing splices and end laps to avoid a four-panel lap splice condition.
 - 8. Lap metal flashing over sheet metal roofing to allow moisture to run over and off the material.
- B. Fasteners: Use fasteners of sizes that will not penetrate completely through substrate.
 - 1. Steel Roofing: Use stainless-steel fasteners.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by fabricator of sheet metal roofing or manufacturers of dissimilar metals.
- D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

- E. Fascia: Align bottom of sheet metal roofing and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal sheet metal roofing with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.5 CUSTOM-FABRICATED SHEET METAL ROOFING INSTALLATION

- A. Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free of buckles, excessive waves, and avoidable tool marks, considering temper and reflectivity of metal. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant. Fold back sheet metal to form a hem on concealed side of exposed edges, unless otherwise indicated.
 - 1. Install cleats to hold sheet metal panels in position. Attach each cleat with two fasteners to prevent rotation.
 - 2. Nail cleats not more than 12 inches o.c. Bend tabs over nails.
- B. Seal joints as shown and as required for leakproof construction. Provide low-slope transverse seams using cleats where backup of moisture may occur.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 - Joint Sealants.
- C. Provide expansion cleats in roof panels that exceed 30 feet in length.
- D. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Do not solder metallic-coated steel or aluminum sheet.
 - 2. Do not pre-tin zinc-tin alloy-coated copper.
 - 3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 - 4. Copper Roofing: Tin edges of uncoated copper sheets, using solder for copper.
- E. Standing-Seam Roofing: Attach standing-seam metal pans to substrate with cleats, double-nailed at 12 inches o.c. Install pans reaching from eave to ridge before moving to adjacent pans. Lock each pan to pan below with transverse seam. Before pans are locked, apply continuous bead of sealant to top flange of lower pan. Crimp standing seams by folding over twice so cleat and pan edges are completely engaged.
 - 1. Loose-lock pans at eave edges to continuous cleats and flanges on back edges of gutters.
 - 2. Fold over seams after crimping at ridges and hips.

3.6 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete sheet metal roofing assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Pipe and Penetration Flashing: Form flashing around pipe penetration and sheet metal roofing. Fasten and seal to sheet metal roofing as recommended by SMACNA.
- D. Roof Curbs: Install curbs at locations indicated on Drawings. Set roof curb so top surface of roof curb is level. Install flashing around bases where they meet sheet metal roofing.
- E. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam sheet metal roofing with clamps or setscrews. Do not use fasteners that will penetrate sheet metal roofing.

3.7 ROOF-EDGE DRAINAGE INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets or straps spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Fasten gutter spacers to front and back of gutter.
 - 2. Loosely lock straps to front gutter bead and anchor to roof deck.
 - 3. Anchor and loosely lock back edge of gutter to continuous cleat.
 - 4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 - 5. Anchor gutter with spikes and ferrules spaced not more than 24 inches apart.

6. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c. in between.
 2. Connect downspouts to underground drainage system indicated.
- D. Splash Blocks: Install where downspouts discharge onto low-slope roofs and where indicated. Set in cement or sealant compatible with roofing membrane.
- 3.8 ERECTION TOLERANCES
- A. Installation Tolerances: Shim and align sheet metal roofing within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- 3.9 CLEANING AND PROTECTION
- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
1. Steel and Aluminum Materials: Clean off excess sealants.
 2. Copper Materials: Clean and neutralize flux materials. Clean off excess solder and sealants.
- B. Remove temporary protective coverings and strippable films, if any, as sheet metal roofing is installed. On completion of sheet metal roofing installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- 3.10 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
 - B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
 - C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
 - D. Prepare test and inspection reports.

END OF SECTION

SECTION 076200
SHEET METAL FLASHING AND TRIM

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. Sheet metal flashing and trim for the following applications:
 - a. Through-wall flashing.
 - b. Formed wall flashing and trim.
 - c. Formed low-slope roof flashing and trim.

- 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 072700 - AIR BARRIERS for perimeter terminations at air and vapor barrier assembly.
3. Section 074200 - METAL WALL PANELS for factory-formed metal wall panels and flashing and trim not part of sheet metal flashing and trim.
4. Section 075400 - THERMOPLASTIC MEMBRANE ROOFING for installing sheet metal flashing and trim integral with roofing membrane.
5. Section 079200 - JOINT SEALANTS for field-applied sheet metal flashing and trim sealants.
6. Section 079500 - EXPANSION CONTROL for manufactured sheet metal expansion-joint covers.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install roof edge flashing and copings capable of resisting Wind Zone forces required by Code according to recommendations in FMG Loss Prevention Data Sheet 1-49.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of

joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. 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. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.
- E. Interface with Other Systems:
1. Do not proceed with installation of flashing and sheet metal until completion of curb and substrate construction, cants, blocking, reglets and other construction required to receive flashing.
 2. Coordinate flashing with other Work for correct sequencing of items comprising entire membrane or system of roofing or waterproofing and rain drainage.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:
1. Identify material, thickness, weight, and finish for each item and location in Project.
 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
 4. Details of expansion-joint covers, including showing direction of expansion and contraction.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

- A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 1. Meet with the Owner, Engineer and Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

- A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. Aluminum Sheet: ASTM B 209, Alloy 3003, 3004, 3105, or 5005. Thickness as specified in this Section. Temper suitable for forming and structural performance required, but not less than H14, finished as follows:
 - 1. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, with No. 2D dull, cold-rolled finish. Thickness as specified in this Section.

2.2 UNDERLAYMENT MATERIALS

- A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- B. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
 - 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 - 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
- C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Isolation Coating: 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.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength. Provide 2 in. min. end dams at terminations (riveted and sealed watertight).
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Soldered Seams in Stainless Steel: Prefabricated inside and outside corners and 2 in. min. end dams at terminations (riveted and soldered watertight).
- D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Caps: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Furnish with 6-inch-wide joint cover plates.
 - 1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
 - 2. Fabricate from the following material:
 - a. Aluminum: 0.050 inch (1.27 mm) thick.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 - 1. Joint Style: Butt, with 12-inch-wide concealed backup plate.
 - 2. Fabricate copings from the following material:
 - a. Aluminum: 0.050 inch (1.27 mm) thick.
- C. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following material:
 - 1. Stainless Steel: 0.025 inch (0.64 mm) thick.

- D. Base Flashing: Fabricate from the following material:
 - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- E. Counterflashing: Fabricate from the following material:
 - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- F. Roof-Penetration Flashing: Fabricate from the following material:
 - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.
- G. Roof-Drain Flashing: Fabricate from the following material:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.
- H. Splash Pans: Fabricate from the following material:
 - 1. Stainless Steel: 0.025 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing, Typical: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams. Fabricate from the following material:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system. Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer installation instructions, and SMACNA "Architectural Sheet Metal Manual". Anchor units work of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints and seams that will be permanently watertight and weatherproof.
1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
1. Coat side of stainless-steel sheet metal flashing and trim with isolation coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip-sheet or install a course of polyethylene underlayment.
 3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Aluminum: Use aluminum or stainless steel fasteners.
2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 - JOINT SEALANTS.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Prein edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Do not solder aluminum sheet.
2. Stainless-Steel Soldering: Prein edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions,] and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.4 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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 firestopping systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
2. Installation Responsibility: Assign installation of through-penetration firestopping systems and fire-resistive joint systems in Project to a single qualified installer.

- 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 joints in or between fire-resistance-rated construction, at exterior curtain wall/floor intersections, and in smoke barriers.
2. Section 079200 - JOINT SEALANTS for standard joint sealants.
3. Section 142100 - ELECTRIC TRACTION ELEVATORS for cutting penetrations for elevator piping, cabling and conduit.
4. Division 21 - FIRE SUPPRESSION for cutting penetrations for fire-protection piping.
5. Division 22 - PLUMBING for cutting penetrations for piping.
6. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for cutting penetrations for duct and piping.
7. Division 26 - ELECTRICAL for cutting penetrations for cable and conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestopping 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 firestopping 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 firestopping 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 firestopping 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 firestopping systems not requiring removal of insulation.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestopping 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 firestopping system configuration for construction and penetrating items.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestopping 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 firestopping systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain through-penetration firestopping systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- B. Installer Qualifications: Either a firm that has been approved by FMG according to FM Approval 4991, "Approval Standard for Firestop Contractors" or a firm experienced in installing through-penetration firestopping 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.

1. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements.

C. Fire-Test-Response Characteristics: Provide through-penetration firestopping 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 firestopping systems acceptable to authorities having jurisdiction.
2. Through-penetration firestopping 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 firestopping system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestopping systems correspond to those indicated by reference to through-penetration firestopping system designations listed in the UL "Fire Resistance Directory."

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestopping 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 firestopping 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 firestopping systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure firestopping materials per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Jobsite conditions of each through-penetration firestopping 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.
 - 1. Verify that the schedule is current at the time of construction, and that each referenced system is suitable for the intended application.
- B. Coordinate work with other trades to assure that penetration-opening sizes are appropriate for penetrant locations.
- C. Coordinate construction of openings and penetrating items to ensure that through-penetration firestopping systems are installed according to specified requirements.
- D. Coordinate sizing of sleeves, openings, core-drilled holes, and cut openings to accommodate through-penetration firestopping systems.
- E. Do not cover up through-penetration firestopping 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 Manufacturers: Subject to compliance with requirements, manufacturers offering products and firestopping systems that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hilti, Inc.
 - 2. RectorSeal.
 - 3. Specified Technologies, Inc. (STI).
 - 4. Tremco.
 - 5. 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 firestopping systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestopping systems, under conditions of service and application, as demonstrated by through-penetration firestopping system manufacturer based on testing and field experience.
- D. Materials: Provide through-penetration firestopping 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: Subject to compliance with requirements, through-penetration firestopping products that may be incorporated into the Work include, but are not limited to the following:
 - 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 MAX Intumescent Firestop Sealant.
 - e. STI; SpecSeal LCI Intumescent Firestop Sealant.
 - f. Tremco; TREMstop Acrylic.
 2. Low-Emitting Materials: Certified Clean Air Gold or GreenGuard Gold certifications.
- E. Accessories: Provide components for each through-penetration firestopping system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for firestopping systems indicated.

2.3 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestopping systems to comply with firestopping 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 firestopping systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestopping 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 firestopping 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. Taping: Use masking tape to prevent through-penetration firestopping 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 firestopping system materials. Remove tape as soon as possible without disturbing firestopping system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestopping systems to comply with Part 1 "Performance Requirements" Article and with firestopping 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 firestopping 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. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports, as required by 2015 IBC 1705.17 and 1705.17.1.
 - 1. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports
 - 2. Cooperate with field quality control personnel. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

- B. Repair or replace work where test results and inspections indicate that it does not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Proceed with enclosing through-penetration firestopping systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.5 CLEANING AND PROTECTING

- A. Clean excess materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestopping 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 firestopping 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. BioFireshield; 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 088000 - GLAZING for glazing sealants.

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. Availavle 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 079500
EXPANSION CONTROL

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. Architectural expansion joint systems for interior and exterior joints as scheduled on the Drawings and specified in this Section.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for block-outs for architectural joint systems in concrete floors, decks, and walls.
 - 2. Section 078446 - FIRE-RESISTIVE JOINT SYSTEMS for fire-resistive joints not associated with expansion control assemblies.
 - 3. Section 079200 - JOINT SEALANTS for elastomeric sealants and preformed compressed-foam sealants without metal frames.

1.3 DEFINITIONS

- A. Architectural Joint System: Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.
- B. Cyclic Movement: Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.
- D. Maximum Joint Width: Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.
- E. Minimum Joint Width: Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.
- F. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage of nominal value of joint width.

- G. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.
 - 1. Vehicular Traffic Joints: Support vehicular traffic across joint, including construction equipment and full-loaded fire apparatus.
 - 2. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
 - 3. Exterior Joints: Maintain continuity of weather enclosure.
 - 4. Joints in Fire-Resistance-Rated Assemblies: Maintain fire-resistance ratings of assemblies.
 - 5. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
 - 6. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
 - 7. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
 - 8. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

1.5 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.
- B. Shop Drawings: For each joint system specified, provide the following:
 - 1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.
- C. Samples for Verification: Full-size units 6 inches long of each type of joint system indicated; in sets for each finish, color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
- D. Product Test Reports: From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

- B. Fire-Test-Response Characteristics: Where indicated, provide joint systems incorporating fire barriers that are identical to those of assemblies tested for fire resistance per UL 2079 or ASTM E 1966, including hose-stream test of vertical wall assemblies and wall-to-ceiling assemblies, by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Balco, Inc.
 - 2. Construction Specialties, Inc.
 - 3. Emseal.
 - 4. InPro Corp.
 - 5. JointMaster/InPro Corporation.
 - 6. Michael Rizza Company, LLC.
 - 7. MM Systems Corporation.
 - 8. Nystrom, Inc.
 - 9. Watson Bowman Acme Corp.; a BASF Construction Chemicals business.
- B. Basis of Design Products:
 - 1. Vertical Joints: Emseal; Seismic Colorseal - DS.
 - 2. Floor Joint at Bridge: InPro Corp.; 806, A01, 075 with EPDM barrier.
 - 3. Underside of Expansion at Roof, Between CLT Members: Emseal; Seismic Colorseal - DS.

2.2 MATERIALS

- A. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6 for sheet and plate.
 - 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Stainless Steel: ASTM A 666, Type 304 with No. 2B finish, unless otherwise indicated, for plates, sheet, and strips.
- C. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

- D. Strip Seals: Elastomeric membrane or tubular extrusions with a continuous longitudinal internal baffle system throughout complying with ASTM E 1783; used with compatible frames, flanges, and molded-rubber anchor blocks.
- E. Compression Seals: Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.
- F. Preformed Cellular Foams: Nonextruded, low-density, crosslinked, nitrogen-blown ethylene-vinyl-acetate copolymer extruded, compressible foam.
- G. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint.
- H. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 ARCHITECTURAL JOINT SYSTEMS

- A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.
 - 1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
 - 2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
 - 3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.
 - 4. Public Area Seals: Non-slip seals designed for installation on treads and risers and to lie flat with adjacent surfaces, and complying with ADA guidelines for public areas.

2.4 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.6 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- C. Bright, Directional Polish: No. 4 finish.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to architectural joint system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.
- D. Provide the services of a surveyor licensed in the **state the project is located** prior to and after paving substrate to confirm alignment of joint.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.
- B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.
- C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.
- D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies to provide continuous, uninterrupted, watertight construction.
- E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.
 - 1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.

2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
 3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
 4. Locate covers in continuous contact with adjacent surfaces.
 5. Securely attach in place with required accessories.
 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.
- F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- G. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.
1. For straight sections, provide preformed seals in continuous lengths.
 2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
 3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
 4. Seal transitions according to manufacturer's written instructions.
 5. Install foam seals with adhesive recommended by manufacturer and heat seal all splices.
- H. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.
- I. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.
- J. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and end joints.

3.3 CLEANING AND PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION

SECTION 081110
HOLLOW METAL 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. Standard hollow-metal steel doors and frames.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 087100 - DOOR HARDWARE for door hardware for steel doors.
 2. Section 088000 - GLAZING for glazed lites.
 3. Section 099000 - PAINTING AND COATING for field painting steel doors and 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 door and frame specified.
- B. Shop Drawings:
1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. 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 door and frame.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Temperature-Rise Limit: Fire door assemblies in interior exit stairways and ramps and exit passageways shall have a maximum transmitted temperature rise of not more than 450 degrees F (250 degrees C) above ambient at the end of 30 minutes of standard fire test exposure. Exception: The maximum transmitted temperature rise is not required in buildings equipped throughout with an automatic sprinkler system installed in accordance with IBC Section 903.3.1.1 or 903.3.1.2.
- D. Fire-Rated, Borrowed-Light Assemblies (Including Sidelights and Transoms): Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and 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. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 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. Ceco Door Products; an ASSA ABLOY Group Company.
 - 2. CURRIES Company; an ASSA ABLOY Group Company.
 - 3. de LaFontaine
 - 4. Philipp Manufacturing Company.
 - 5. 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. Environmental Product Declarations (EPD): Product-specific Type III EPDs for hollow metal doors and frames are available from manufacturers listed herein.
- K. Low-Emitting Materials: Provide building products 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."

2.3 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Exterior Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 2.5 when tested according to ASTM C 1363. Thermal doors to be fire rated as indicated.
 - 3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.
 - 4. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated (galvanized/galvannealed) steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated (galvanized/galvannealed) steel sheet.
 - 1. Fabricate frames with full profile welded joints.
 - 2. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with full profile welded joints.
 - 2. Frames for Level 2 Steel Doors: 0.053-inch-thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Timber Type: As recommended by manufacturer for application indicated.
 - 4. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 5. 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.

2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.

2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Full Profile Welded Frames: Weld joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
 - 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as doorframe. Fasten members at crossings and to jambs by butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 5. 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 and Timber 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.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings, so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow metal work.

5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.10 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard 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 doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

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

- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 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 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. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. 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.
- C. Metallic-Coated (Galvanized/Galvannealed) Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 084110
ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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 aluminum-framed storefronts.
2. Exterior swing aluminum doors.

- 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 installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.
2. Section 087100 - DOOR HARDWARE for lock cylinders and keying.
3. Section 088000 - GLAZING for glazing requirements to the extent not specified in this Section.
4. Section 089000 - LOUVERS AND VENTS for units installed with aluminum-framed systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design entrance and storefront system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Dimensional tolerances of building frame and other adjacent construction.
4. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.

- e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
 - g. Failure of operating units to function properly.
- C. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.
- D. Deflection of Framing Members:
- 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.
- E. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. Air Infiltration: Provide doors and storefront which comply with the following. Test unit in accordance with ASTM E 283.
- 1. Swinging Entrance Doors, ASHRAE Requirement: 1.0 cfm/sf maximum air leakage at a pressure differential of 1.57 psf.
 - 2. Storefront, ASHRAE Requirement: 0.06 cfm/sf maximum air leakage at a pressure differential of 1.57 psf or higher.
- G. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.
- 1. Test Pressure: 8 psf.
 - 2. Performance: No leakage as defined in test method at specified test pressure. No uncontrolled water penetrating system or appearing on normally exposed interior surfaces.
- H. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.
- I. Thermal Transmittance: Provide window units that have a U-value as required by Code rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.

- J. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 65 for fixed storefront units and not less than 55 for doors when tested according to AAMA 1503.

1.4 SUBMITTALS

- A. Product Data: Include installation instructions, construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated. Indicate special procedures and perimeter conditions requiring special attention.
- B. Shop Drawings: Prepared under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum-framed systems. For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
 - 3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.
 - 4. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
 - 5. Wiring diagrams for power, signal, and control wiring.
 - 6. Activation and safety devices.
 - 7. Include full-size isometric details of each vertical-to-horizontal intersection of storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions
 - d. Glazing
 - e. Flashing and drainage.
 - 8. Include details showing interface with perimeter conditions to depict interface with adjacent thermal, weather, air and vapor barriers, and adjacent flashings.
 - 9. Shop drawings must be signed and stamped by a professional engineer.
- C. Delegated-Design Submittal: For entrance and storefront systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Show structural testing for attachment of the storefront to the existing structure. Contractor should survey slab edge locations and conditions of the embeds to develop the attachment details.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

- G. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:
 - 1. U-value.
 - 2. Solar heat-gain coefficient.
- H. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

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 entrance and storefront systems that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.
- D. Accessible Entrances: Comply with authorities having jurisdiction, local state building code and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)", and Department of Transportation Americans with Disabilities Act (ADA) Standards for Transportation Facilities 2006.
- E. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to storefront system, including, but not limited to, the following:
 - 1. Review structural load limitations.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review required testing, inspection, and certifying procedures.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems 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 aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

- A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Faulty operation of operators, controls, and hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

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. Storefront, 1-3/4 inch by 4-1/2 inch profile:
 - a. Basis of Design: EFCO Corporation, 401 NT.
 - b. Kawneer North America, Trifab 400.
 - c. Oldcastle BuildingEnvelope, FG-1000.
 - d. Tubelite Inc., INT45.
 - e. YKK AP America Inc., YES 40 FS.
 - 2. Doors, Medium Stile:
 - a. Basis of Design: EFCO Corporation, D-300.
 - b. Kawneer North America, 350.
 - c. Oldcastle BuildingEnvelope, MS-375.
 - d. Tubelite Inc., Medium.
 - e. YKK AP America Inc., 35D.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Structural Profiles: ASTM B 308/B 308M.
 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Dual thermal-break.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.
- F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 - GLAZING.
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.5 DOORS

- A. Doors: Manufacturer's standard glazed doors, for swing operation.
 - 1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

2.6 DOOR HARDWARE

- A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.
 - 1. Opening-Force Requirements:
 - a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.
- B. Pivot Hinges: BHMA A156.4, Grade 1.
- C. Locking Devices, General: Do not require use of key, tool, or special knowledge for operation.
 - 1. Opening-Force Requirements:
 - a. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
 - b. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 - 1. Standard: BHMA A156.3, Grade 1.
- F. Cylinders: As specified in Section 087100 - DOOR HARDWARE.
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Closers: With accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use, and adjustable to meet field conditions and requirements for opening force.
 - 1. Standard: BHMA A156.4, Grade 1.
- J. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- K. Surface-Mounted Holders: BHMA A156.16, Grade 1.

- L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- M. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- N. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- O. Silencers: BHMA A156.16, Grade 1.
- P. Thresholds: Raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (13 mm).
 - 1. Standard: BHMA A156.21.
- Q. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 ACCESSORY MATERIALS

- A. Insulating Materials: As specified in Section 072100 - THERMAL INSULATION.
- B. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 - JOINT SEALANTS.
- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).
- E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- F. Doors: Reinforce doors as required for installing hardware.
 - 1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 5000 by Solvay; or equal. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: EFCO Mineral Brown.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 - JOINT SEALANTS and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Install glazing as specified in Section 088000 - GLAZING.

1. Structural-Sealant Glazing:

- a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- b. Install weatherseal sealant according to Section 079200 - JOINT SEALANTS and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.
2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
 1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under Part 1 "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.
 2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under Part 1 "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.
 3. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

- A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.
 1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

END OF SECTION

SECTION 084410
GLAZED ALUMINUM CURTAIN WALLS

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. Glazed aluminum-framed curtain wall systems.

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

1. Section 078440 - FIRE-RESISTIVE JOINT SYSTEMS for perimeter fire-containment systems (safing insulation) field installed with glazed aluminum curtain wall systems.
2. Section 079200 - JOINT SEALANTS for installation of joint sealants installed with glazed aluminum curtain wall systems and for sealants to the extent not specified in this Section.
3. Section 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS for entrance and storefront systems.
4. Section 088000 - GLAZING for glass and glazing of aluminum curtain wall systems.
5. Section 089000 - LOUVERS AND VENTS for units installed with glazed aluminum curtain wall systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glazed curtain wall, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. General: Provide glazed aluminum curtain wall systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
4. Dimensional tolerances of building frame and other adjacent construction.
5. Failure includes the following:

- a. Deflection exceeding specified limits.
 - b. Thermal stresses transferred to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.
 - d. Noise or vibration created by wind and thermal and structural movements.
 - e. Loosening or weakening of fasteners, attachments, and other components.
 - f. Sealant failure.
- C. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.
- D. Structural-Test Performance: Provide glazed aluminum curtain wall systems tested according to ASTM E 330 as follows:
- 1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Duration: As required by design wind velocity but not less than 10 seconds.
- E. Deflection of Framing Members:
- 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches, and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
- F. Story Drift: Provide glazed aluminum curtain wall systems that accommodate design displacement of adjacent stories indicated.
- 1. Design Displacement: As indicated on Drawings.
 - 2. Test Performance: No glass breakage, anchor failures, or structural damage when tested according to AAMA 501.4.
- G. Thermal Movements: Provide glazed aluminum curtain wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- H. Air Infiltration: Provide glazed aluminum curtain wall systems with maximum air leakage of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.

- I. Water Penetration Under Static Pressure: Provide aluminum glazed curtain wall systems that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 12 lbf/sq. ft.
 - 1. Maximum Water Leakage: No uncontrolled water penetrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained to exterior and cannot damage adjacent materials or finishes is not considered water leakage.
- J. Condensation Resistance: Provide glazed aluminum curtain wall systems with condensation-resistance factor (CRF) of not less than 75 when tested according to AAMA 1503.
- K. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum as required by Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.
- L. Thermal Transmittance: Provide window units that have a U-value as required by Code rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft. Submit proof of compliance with submittals as specified.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of glazed aluminum curtain wall systems.
 - 1. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.
 - 2. Include weatherproofing, drainage and anchorage provisions.
 - 3. Include details, materials, adjacent and adjacent construction. Include isometric views of complex intersections.
- C. Delegated-Design Submittal: For glazed curtain wall system 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. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of systems, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.

4. Glazing.
 5. Flashing and drainage.
- F. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:
1. U-value.
 2. Solar heat-gain coefficient.
- G. Compatibility Test Reports: Test reports by glazing and/or sealant manufacturers that show chemical compatibility and adhesion (if required) between all non-aluminum components including, but not limited, to:
1. Gaskets
 2. Insulated glass edge seals
 3. Setting blocks
 4. Anti-walk blocks
 5. End dams
 6. Sealants
 7. Silicone sheet membrane flashing
- H. Welding certificates.
- I. Qualification data for Installer.
- J. Field quality-control test reports.
- K. Warranties: Special warranties specified in this Section.

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 state the 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 glazed curtain wall system that are similar to those indicated for this Project in material, design, and extent.
- C. Installer Qualifications: Capable of assuming engineering responsibility and performing Work of this Section and who is acceptable to manufacturer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field-testing, and in-service performance.

- E. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."
- F. Installation Sequence Conference: Conduct conference at Project site to review sequence of installation of curtain wall systems, including installation of joint sealants, flashing, and glass. Conference shall be attended by all installers of applicable components.
- G. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as indicated on Drawings.
 - 2. Build mockup in sequence recommended by manufacturer including installation of joint sealants, flashing and glass.
 - 3. The construction of the mockup shall be observed by all tradesmen constructing the curtain wall system.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01. Review methods and procedures related to glazed aluminum curtain wall systems including, but not limited to, the following:
 - 1. Review structural load limitations.
 - 2. Review installation sequence, including installation of sealants, flashing, and glass.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required testing, inspecting, and certifying procedures.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain wall systems 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 glazed aluminum curtain wall systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.
 - c. Deterioration of metals and other materials beyond normal weathering.
 - d. Water leakage.
 - e. Failure of operating components to function normally.

2. Warranty Period: Three years from date of Substantial Completion.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: Ten years from date of Substantial Completion.

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. Curtain Wall - Pressure Plate System:
 - a. Basis of Design: Kawneer North America, 1600 System 1.
 - b. EFCO Corporation.
 - c. Oldcastle BuildingEnvelope.
 - d. Wausau.
 - e. YKK AP America Inc.

2.2 FRAMING SYSTEMS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 611.
 3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce members as required to receive fastener threads.
 3. Where acceptable, use exposed fasteners with countersunk Phillips screw heads.

4. Finish exposed portions to match framing system.
 5. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
- E. Anchors: Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- G. Joint Sealants: Provide manufacturer recommended sealants for seams and joints within aluminum framing system.

2.3 GLAZING SYSTEMS

- A. Glazing: As specified in Section 088000 - GLAZING.
- B. Glazing Gaskets: Manufacturer's standard compression types, replaceable, molded or extruded, that maintain uniform pressure and watertight seal.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

2.4 SPANDREL PANELS

- A. Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
1. Overall Panel Thickness: As indicated on Drawings.
 2. Exterior and Interior Skin: Aluminum.
 - a. Thickness: Manufacturer's standard for finish and texture indicated.
 - b. Finish: Matching framing system.
 - c. Texture: Smooth.
 - d. Backing Sheet: Manufacturer's standard.
 - e. Core: Manufacturer's standard.

2.5 ACCESSORY MATERIALS

- A. Perimeter Fire-Containment Systems (Safing Insulation): Specified in Section 078440 - FIRE-RESISTANT JOINT SYSTEMS.
- B. Insulating Materials: Specified in Section 072100 - THERMAL INSULATION.
- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
- D. Silicone Membrane: Pre-cured silicone sheet that is physically and chemically compatible with the approved silicone sealant for the curtain wall system.

- E. Foam Tape: Foam glazing tape with adhesive on one side. Select the thickness and width to provide an adequate air and water seal and to provide adequate clamping pressure to silicone flashing.

2.6 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Sharp profiles, straight and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to prevent glazing-to-glazing contact and to maintain required glazing edge clearances.
- C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 5000 by Solvay; or equal. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: To match storefront.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

- 1. Comply with manufacturer's written instructions.
- 2. Do not install damaged components.
- 3. Fit joints to produce hairline joints free of burrs and distortion.
- 4. Rigidly secure nonmovement joints.
- 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- 6. Seal joints watertight, unless otherwise indicated.

B. Connecting and Sealing to Adjacent Enclosure Systems:

- 1. At locations where the curtain wall will be installed adjacent to back vented and drained rain screen wall systems, connect the curtain wall to the water-resistive barrier of the adjacent wall system with silicone membrane flashing.
- 2. Seal and clamp the silicone membrane into the curtain wall glazing pocket.
 - a. Use a sealant that is compatible with the silicone membrane and the silicone in the joints of the curtain wall system.
 - b. Use an L-shaped pressure bar with applied foam tape to clamp the silicone membrane to the curtain wall mullion.
- 3. Notch the stem on vertical mullions as needed to install flashing at the tops and bottoms of the curtain wall. Flashing shall be continuously sealed and clamped into the curtain wall glazing pocket and sealed to adjacent air barrier or enclosure system as indicated on the Drawings. Install similar flashing at the jambs of the curtain wall to provide continuous perimeter flashing.
- 4. At locations where the curtain wall will be installed adjacent to roofing systems connect the curtain wall to the roofing vapor barrier and the roof membrane. The roofing vapor barrier may be adhered directly to the inboard side of the curtain wall. Provide a metal backpan if needed to allow for this connection. Connect the roofing membrane to the curtain wall by transitioning the roof membrane to a silicone sheet membrane.
 - a. Provide stainless steel sheet or foil-faced membrane as needed to transition between the roofing membrane and the silicone sheet.
 - b. Seal and clamp the silicone sheet into the curtain wall as described above.

C. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- E. Install components plumb and true in alignment with established lines and grades.
- F. Coordinate with glazing and installation of glazing which is specified in Section 088000 - GLAZING.
- G. Coordinate with sealants and installation of perimeter sealants which is specified in Section 079200 - JOINT SEALANTS.
- H. Coordinate with insulation and installation of insulation which is specified in Section 072100 - THERMAL INSULATION.
- I. Coordinate with materials and installation for perimeter fire-containment systems (safing insulation) which is specified in Section 078440 - FIRE-RESISTIVE JOINT SYSTEMS.
- J. Erection Tolerances: Install glazed aluminum curtain wall systems to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet ; 1/4 inch in 40 feet.
 2. Level: 1/8 inch in 20 feet ; 1/4 inch in 40 feet.
 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or greater, limit offset from true alignment to 1/4 inch.
 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed system with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified under Part 1 "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed

- wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft.
2. Water Penetration: Areas shall be tested according to ASTM E 1105 at minimum static-air-pressure difference of 0.67 times the pressure specified under Part 1 "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. and shall not evidence water penetration.
 3. Water Spray Test: After the installation of minimum area of 75-feet-by-2-story glazed aluminum curtain wall system has been completed but before installation of interior finishes has begun, a 2-bay area of system designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 –GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF THE WORK

- A. The work of this section includes the furnishing of door hardware as shown on the Drawings and as herein specified for the proper operation of wood and hollow metal doors which, without limiting the generality thereof includes:
1. Furnishing all required templates and schedules.
 2. Installation Instructions.
 3. Delivery of door hardware under this Section to the Contractor for installation.
 4. Coordinate work with related trades.
- 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 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
1. Section 062000 – FINISH CARPENTRY
 2. Section 081113- METAL DOORS AND FRAMES
 3. Section 084313 – ALUMINUM-FRAMED STOREFRONTS
 4. Division 26 – ELECTRICAL
 5. Division 28 – ELECTRONIC SAFETY AND SECURITY

1.4 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
1. Americans with Disabilities Act (ADA):
Providing Accessibility and Usability for Physically Handicapped People.

2. Door and Hardware Institute (DHI):
Ref. 1 Recommended Locations for Builders Hardware.

1.5 SUBMITTALS:

- A. Schedules: Submit a complete Hardware Schedule, in DHI vertical format through the General Contractor for approval by the ARCHITECT/SPECIFIER. The Schedule shall list the 087100 Specification Hardware Set number next to the Schedule Heading Number and shall include a Door Index listing doors in numerical order with Schedule Heading Numbers and a condensed list of products, manufacturers, and quantities scheduled therein. Submittal shall be in Electronic PDF Format.
- B. Catalog Cuts: Include with the Schedule two sets of catalogue cuts, together with product data sheets and installation instructions of all hardware items.
- C. Templates: All required templates shall be furnished in accordance with the schedule. Furnish templates to the door and frame manufacturer sufficiently in advance so as not to delay progress of the work. However, no templates shall be issued or materials ordered until the schedule has been approved.
- D. Samples: A sample of each item of hardware the successful bidder proposes to furnish shall be submitted for approval not later than ten (10) days after being requested. After review, samples shall be returned to the Supplier.
- E. Shop Drawings: Details of electrified door hardware, indicating the following:
 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. System schematic.
 - b. Point-to-point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
 2. Detail interface between electrified door hardware and fire alarm access control and building control and security systems.

1.6 WARRANTY/GUARANTEE

- A. Attention is directed to the provisions of the CONDITIONS OF THE CONTRACT regarding warranties for the Work.
- B. Manufacturers shall provide their standard warranties/guarantees for work under this Section. However, such warranties/guarantees shall be in addition to, and not in lieu of, all other liabilities which the manufacturers may have by law or by other provisions of the Contract Documents.

1.7 KEYING

- A. Grandmaster Key and Master Key all locks and cylinders into a new Interchangeable Core Key System as directed by the Owner. Basis of design shall be Medeco X4.
- B. The General Contractor shall provide all cylinders with Construction Cores for use during construction. Permanent cores shall be shipped directly to the Owner for installation after job completion. All Construction Cores shall be returned to the Supplier upon substantial completion of the project (non-returned Cores shall be subject to invoicing).
- C. The hardware supplier shall prepare an internal Keying Legend for the purpose of discussion in establishing the Permanent Keying Hierarchy. General Contractor shall arrange for a meeting with the Owner to finalize keying for this job. Owner shall approve the final Keying Legend Submittal.
- D. Furnish the following quantities of keys (Owner to verify):

- Four (4)Grand Master Keys
- Four (4)Master Keys each Set
- Three (3) Change Keys each locking device
- Six (6)Construction Master Keys
- Two (2)..... ControlKeys

Keys shall be stamped, "DO NOT DUPLICATE".

- E. Installation of permanent cores shall be the responsibility of the Contractor as directed by the Owner.

1.8 SPECIAL REQUIREMENTS

- A. Hardware Supplier shall determine conditions and materials of all doors and frames for proper application of hardware.
- B. Hardware Supplier shall be responsible for the accuracy of the quantities, sizes, finish and proper hardware to be furnished, whether specifically listed or not, and shall be responsible for determining all details, such as and of doors, bevel of locks, etc.
- C. All lever trim for door locks to hazardous areas such as Mechanical, Electrical, Elevator Machine Rooms, etc., shall have a tactile surface to comply with requirements of the Authority Having Jurisdiction.
- D. Tools for Maintenance: All special tools packed with hardware items shall be saved and turned over to the Owner upon completion of the Work.
- E. Lock fronts, flush bolt faces, and strikes shall be beveled in accordance with manufacturer's standards.
- F. Furnish strikes as required by details.

- G. Handing of doors shall be verified by this supplier.
- H. Refer to Hollow Metal, Wood and Aluminum Sections regarding adequate blocking and reinforcing for surface applied hardware. The use of thru-bolts shall be prohibited.
- I. All electrified hardware items are to be interfaced with the Fire Alarm System and/or Security System.

CR = Card Reader
 DC = Door Contact (Sentrol 1076)
 PS = Power Supply
 RX = Request to Exit

- J. Hardware not specifically listed for a particular opening shall be the same as hardware scheduled for similar openings.

PART 2 - PRODUCTS

2.0 QUALITY ASSURANCE

- A. Hardware shall be furnished as specified herein.
- B. All hardware shall be entirely free from imperfection in manufacture and finish. It is the responsibility of the Hardware Supplier to follow the manufacturers' catalogue requirements for the proper size and weight of hardware and fastenings, and the proper function of hardware in each case. All door sizes are to be noted on the Door Schedule and all hardware shall be in strict accordance with requirements of height, width, and thickness.

2.1 QUALITY OF MATERIALS

- A. The numbers used below to set a standard of quality for the major products for this project are taken from the catalogs of those manufacturers whose names appear parentheses. Equivalent products of other manufacturers are acceptable provided said products are equal to the items specified in quality, weight, design, and function.

| <u>ITEM</u> | <u>MANUFACTURERS</u> |
|----------------------|-----------------------------|
| Continuous Hinges | (ABH) McKinney, Select |
| Locksets | (Schlage) Frascio, Sargent |
| Exit Devices | (Von Duprin) Detex, Sargent |
| Closers | (Norton) Dorma |
| Pulls | (Rockwood) Hager, Trimco |
| OH Stops | (ABH) GJ, Rixson |
| Thresholds/Gasketing | (Pemko) NGP, Reese |
| ADA Power Operators | (Dorma) LCN, Motion Access |

2.2 CONTINUOUS HINGES

- A. Continuous Hinges for all doors shall be stainless steel, ABH A5500. Furnish EPT cutouts where required.

Width of hinges shall be determined by trim conditions.

2.3 LOCKSETS

- A. Unless noted otherwise, Locksets shall be heavy-duty mortise type, Schlage "L9000-03A" Lever Trim, in functions as noted in the Hardware Sets below.
- B. All locks shall be furnished with 2-3/4 in. backset and wrought box strikes.
- C. Furnish strikes with extended lips at deep reveals and where required to protect trim from being marred by latchbolt. At Prs. of Doors, strike shall be 7/8" Lip-to-Center.
- D. Furnish Interchangeable Core Cylinders for all locking devices on this project.

2.4 EXIT DEVICES

- A. Exit Devices shall be Von Duprin "98" Series, in applications as noted in the HW Sets below. Furnish narrow stile devices where required.
- B. Lever trim shall match lockset trim.

2.5 CLOSERS

- A. Unless otherwise indicated in the HW Sets below, Overhead Surface Closers shall be Norton, non-sized, ADA approved, as follows
 - Exterior Doors 7500-SS-Top Jamb
 - Interior Doors 7500-SS Series. Furnish arm functions as noted in the HW Sets below.
- B. Unless specified otherwise, closers shall be mounted on that side of the opening least objectionable to the public view. Provide parallel arm type at reverse bevel conditions.
- C. Template and install all door closers for the maximum degree of opening as indicated on the drawings (except where built in stops are specified).
- D. Dorma STA-8900 is an acceptable equal.

2.6 DOOR PULLS/PROTECTION PLATES

- A. Special Pulls shall be Rockwood RM3312-MP-90" x Type 12XHD. Midposts to be located 10" below Top Post.

- B. Flush Pulls shall be Rockwood 94.
- C. Push Bars shall be Rockwood SP47 x Type 12XHD.
- D. Kick Plates shall be Rockwood K1062, 10" high x 2" LWOD.

2.7 STOPS

- A. Overhead Stops shall be ABH N-9020 Series. N-1020 Series acceptable (if required by Door Manufacturer). Furnish Special Template for Top Jamb Closers/ADA Operators.

2.8 GASKETING/THRESHOLDS

- A. Gasketing shall be Pemko S773BL, applied at head and jambs.
- B. Sweeps shall be Pemko 315SSN.
- C. Rain Drips shall be Pemko 346C and shall be furnished for all exterior doors.
- D. Thresholds for exterior outswing doors shall be Pemko 2705AKT. Refer to specific details.
- E. All Thresholds shall be cut-in around mullions, frame members, stops, mullions (not butted up against) and shall provide a continuous surface across the full width of the opening from jamb to jamb. All Thresholds shall be properly sealed, grouted and/or caulked and set in a full bed of mastic.

2.9 ADA POWER OPERATORS

- A. ADA Power Operators shall be Dorma ED250-FINE. Furnish (2) BEA 10MS31J-B Touchless Actuators (locate as directed). Furnish Weatherproof Housing at exterior locations. Interface Operators with Electrified Hardware and Access Control System. Operators shall be furnished and installed by factory trained, AAADM Certified technicians. Furnish necessary Safety Sensors/Signage as required by awarded Door Manufacturer.

2.10 MISCELLANEOUS

- A. Furnish (1) Knox Box, Model 3200-R. Locate as directed.
- B. Electric Power Transfers shall be ABH PT180-12WIRE-EZ.
- C. Electric Strikes shall be Von Duprin 6200/6300 Series to suit application.

2.11 FINISHES

- A. Unless otherwise noted, finish shall be as follows:

1. Continuous Hinges, Locksets, Exit Devices, Protection Plates, etc. shall be POLISHED stainless steel (US32/629). Plates shall be B.S. .062 ga.
2. Pulls (& Posts) shall be Polished Stainless Steel, US32-316 Alloy.
3. Thresholds shall be Aluminum.
4. Closers shall be painted aluminum (689).
5. Adhesive Gasketing shall be Black.

PART 3 - EXECUTION

3.01 MOUNTING POSITIONS

- A. Mounting heights given are centerline heights from finished floor.
- B. Hinges: Position top hinge five inches below head, bottom hinge ten inches above finished floor and intermediate hinge equally spaced between top and bottom hinges.
- C. Locksets/Exit Devices: Unless shown otherwise, locate center of levers 40 inches above finished floor (or per manufacturers standard locations).
- D. Overhead Closers:
 1. Verify each head condition prior to furnishing door closers.
 2. Surface-mounted on Door: Surface shoe application for standard operation and soffit plate application for parallel arms. Provide special shoe plates and brackets where specified or where required by job conditions.
 3. Set hardware plumb, level and in exact alignment and location. Conceal and countersink fasteners wherever possible.

3.02 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust hardware items to work smoothly, easily and correctly.
- B. Clean exposed surfaces using non-abrasive materials and methods recommended by the manufacturer of the hardware being cleaned. Remove and replace work, which cannot be successfully cleaned, as judged solely by the Architect.
- C. Provide temporary protection to ensure work being done without damage or deterioration at time of Final Acceptance. Levers shall be kept covered with heavy cloth, and other hardware shall be protected against damage until Substantial Completion of the Project. Remove protections and reclean as necessary immediately prior to Final Acceptance.

3.03 COMPLETION AND CONTINUED MAINTENANCE

- A. Before completion of work of this Section, inspect work with Architect and adjust and correct work to leave operating parts in perfect operating condition, jointing to adjacent

material tight, surfaces without blemishes or stains, work properly executed and complete, and defects and damaged work replaced or corrected.

3.04 HARDWARE SETS

- A. Each Hardware Set listed below represents the complete hardware requirements for one opening (single door or pair of doors). Furnish the quantities required of each set for the work.
- B. The numbers used opposite locksets/exit devices to identify the function are Schlage/Von Duprin numbers.
- C. HW Sets that do not appear on the Door Schedule shall be considered “Not Used” and/or saved for future use.
- D. Security items are listed below the individual Hardware Sets for Hardware Set coordination and templating for doors and frames only. Refer to Security Section for details.

HW-1
101A

| | |
|----------------------------|--------------------------------------|
| 2 Continuous Hinges | |
| 1 Electric Exit Device | RX-QEL-9847TL/NL x 376T (Nightlatch) |
| 1 Electric Exit Device | RX-QEL-9847EO (Exit Only) |
| 2 Electric Power Transfers | |
| 2 Pulls | Special |
| 1 ADA Power Operator | |
| 1 Closer | |
| 2 OH Stops | |
| Gasketing | By Door Manufacturer |
| 1 Threshold | |
| CR, DC & PS | By Security |
| 24V/120V | |

HW-2
101B, 111

| | |
|----------------------|------------------------------------|
| 1 Continuous Hinge | |
| 1 Deadlock | Adams Rite MS1950P x (2) Cylinders |
| 1 Push Bar | |
| 1 Pull | Special |
| 1 ADA Power Operator | |
| 1 OH Stop | |
| Gasketing | By Door Manufacturer |
| 1 Threshold | |
| 120V | |

HW-3
103A, 113A

| | |
|-----------------|------|
| 2 Spring Hinges | 1552 |
|-----------------|------|

1 Lockset
1 Set Gasketing

26 (Exit)

HW-4
102, 112

1 Continuous Hinge
1 Electric Lockset
1 Electric Power Transfer
1 Electric Strike
1 Flush Pull
1 Closer
1 Kick Plate
1 OH Stop
1 Set Gasketing
1 Sweep
1 Threshold
CR, DC & PS

RX-26 (Exit)

By Security

HW-5
103, 113

1 Continuous Hinge
1 Electric Exit Device
1 Electric Power Transfer
1 Electric Strike
1 Flush Pull
1 Closer
1 Kick Plate
1 OH Stop
1 Set Gasketing
1 Sweep
1 Threshold
CR, DC & PS
24V

RX-98NL-OP-F x 110NL

By Security

- END OF SECTION -

SECTION 088000
GLAZING

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. Glazed entrances and storefronts specified in Section 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
 - b. Glazed curtain walls specified in Section 084410 - GLAZED ALUMINUM CURTAIN WALLS.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage

attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed 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.

1.5 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.

1.6 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. 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.
- H. 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."
- I. 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.

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

1.7 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.

1.8 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.

1.9 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.

PART 2 - PRODUCTS

2.1 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. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
 2. For uncoated glass, comply with requirements for Condition A.
 3. For coated vision glass, comply with requirements for Condition C (other coated glass).
- C. Coated Float Glass: Pyrolytic and vacuum deposited coatings on glass in conformance with ASTM C 1376.
- D. Uncoated Tinted Float Glass: Class 2, complying with other requirements specified.
1. Tint Color: As selected by the Architect.
 2. Visible Light Transmittance: As standard with manufacturer.
- E. Tempered Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; Kind FT; 1/4 inch thick unless indicated otherwise.
- F. Patterned Glass: ASTM C 1036, Type II (patterned and wired flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.
- G. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction for Framed Units: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
 2. Construction for Units with Exposed Edges: Laminate glass with cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written recommendations.
 3. Interlayer Thickness: 0.030 inch (0.76 mm) thick for vertical glazing, 0.060 inch (1.52 mm) thick for sloped glazing.
 4. Interlayer Color: Clear unless otherwise indicated.

2.2 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.

2.3 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.

2.4 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. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.
- G. 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.
- H. 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.

2.5 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.

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 089000
LOUVERS AND 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 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. Fixed extruded-aluminum louvers and frames to be installed in Aluminum-Framed Storefront and Glazed Aluminum Curtain Wall.
- 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 sealants installed in perimeter joints between louver frames and adjoining construction.
 - 2. Section 084110 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS for storefront framing.
 - 3. Section 084410 - GLAZED ALUMINUM CURTAIN WALL.
 - 4. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide louvers capable of withstanding the effects of gravity loads and wind loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act on vertical projection of louvers. Loads as required by Code.
- B. Seismic Performance: Provide louvers capable of withstanding the effects of earthquake motions as required by code.

- C. Thermal Movements: Provide louvers 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 ambient; 180 deg F material surfaces.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.
 - 1. For installed louvers indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 2. Include sill, jambs, and head details showing the integration with adjacent air and water barriers.
 - 3. Include details of the continuous sill pan with upturned back and end dams. Note on drawings how continuity will be maintained at the sill pan corners.
- C. Samples for Verification: For each type of metal finish required.
- D. Qualification Data: For professional engineer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code--Aluminum."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings 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 opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 FIXED, EXTRUDED-ALUMINUM LOUVERS

- 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. Airolite Company, LLC.
 2. American Warming and Ventilating.
 3. Construction Specialties, Inc.
 4. Industrial Louvers, Inc.
- B. Horizontal Storm-Resistant Louvers:
1. Louver Depth: As indicated on the Drawings.
 2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch.
 3. Performance Requirements: AMCA 550.
 4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
 5. Free Area: Comply with requirements indicated on the Drawings.
- C. General: Provide screen at each exterior louver. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c. Fabricate frames with mitered corners to louver sizes indicated.
1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Bird screening, aluminum, 1/2-inch-square mesh, 0.063-inch wire

2.2 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Coatings shall be fluorosurfactant free Kynar 500 by Arkema or fluorosurfactant-compliant Hylar 5000 by Solvay; or equal. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.
1. Color and Gloss: As selected by Architect from manufacturer's full range. To match Aluminum-Framed Storefront and Glazed Aluminum Curtain Wall.

- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable only if they are within the range of approved Samples, or shall not exceed $DE^*a^*b^*$ of 2.0 from a single control sample. Noticeable variations in the same piece are not acceptable.'

2.3 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- D. Integral sills shall include a continuous sill pan with back and end dams. Water that runs off the louver shall be collected in the sill pan and drained away from the building.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Fully Recessed Mullions: Provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
- G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 - JOINT SEALANTS for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

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. Acoustic insulation (sound attenuation batts) in gypsum wallboard assemblies.
 3. Non-load-bearing steel framing, including angles in partial-height partitions.
 4. Marking and identification for fire- and smoke-partitions.
- 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 framing and plywood backing panels.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance:
1. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure.
 2. Provide metal framing engineered to meet code requirements, project requirements, required heights, and the following deflection criteria. 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 shafts.
 3. Provide fire stop tracks capable of withstanding deflection within limits and under conditions indicated.
- B. Marking and Identification for Fire- and Smoke-Partitions: Fire walls, fire barriers, fire partitions, smoke barriers, smoke partitions and other walls required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
1. Be located in accessible concealed floor, floor-ceiling or attic spaces; and

2. Locate within 15 feet of end of each wall and repeat at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
3. Include lettering not less than 3 inches in height with a minimum 3/8 inch stroke in contrasting color, incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," or other wording.
4. Exception: Walls in Group R-2 occupancies that do not have a removable decorative ceiling allowing access to the concealed space.

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 and project requirements. and specified deflection criteria.
- C. Samples: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

- a. Each level of gypsum board finish indicated for use in exposed locations.
- b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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. Chicago Metallic Corporation; Drywall Furring System.
 - 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. EB Metal U.S.
 3. Marino\WARE.
 4. Studco Building Systems.
- 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. 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).
- D. 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.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0312 inch (20 gauge).
 2. Depth: 1-1/2 inches.
- F. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- G. 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. Georgia-Pacific (G-P) Gypsum.
 3. National Gypsum Company.
 4. United States Gypsum Company (USG).
- B. Gypsum Wallboard: ASTM C 1396.
1. Available Products: USG; SHEETROCK EcoSmart Panels.
 2. Thickness: 1/2 inch and 5/8 inch as indicated.
 3. Long Edges: Tapered.
 4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
 5. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.
- C. Gypsum Wallboard, Fire-Resistant Type X: ASTM C 1396.
1. Available Products: USG; SHEETROCK EcoSmart Panels Firecode X.
 2. Thickness: 5/8 inch.
 3. Long Edges: Tapered.
 4. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.
 5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
 6. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc, with flanges for mechanical fastening, unless otherwise indicated.
 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint. For control joints in fire rated walls provide Cemco FAS 093X fire-rated control joint or equal.
 - 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.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Wallboard: Paper.
- 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.

2.7 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. 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: 50 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.
- 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 units, use screws of type and size recommended by panel manufacturer.

3. For fastening abuse-resistant gypsum panels, use Type S 'high-low' screws.
 4. For fastening impact-resistant gypsum panels, use Type S 'high-low' screws.
- 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. CertainTeed Corporation; NoiseReducer.
 - b. Johns Manville; Unfaced Formaldehyde-Free Fiber Glass Insulation.
 - c. Knauf Insulation; EcoBatt.
 - d. Owens Corning; PINK Next Gen Fiberglass Sound Attenuation Batts (SAB).
 - e. Owens Corning; Thermafiber SAFB FF.
 - f. Rockwool (formerly Roxul); AFB evo.
 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD).
 4. Recycled Content: Use minimum recycled content of 25%.
 5. Building Product Disclosure and Optimization, Material Ingredients: Health Product Declaration (HPD) or Declare product labels.
 6. Low-Emitting Materials, General Emissions Evaluation: GreenGuard Gold certification.
- 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.

2.8 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.
 - 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.

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 (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, 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.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

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. 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 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.

3.9 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: Comply with GA-214. Finish panels to levels indicated below:
 - 1. Level 1: Ceiling plenum areas and concealed areas not exposed to view.
 - 2. Level 2: 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: Not Used.

3.10 INSTALLING IDENTIFICATION FOR FIRE- AND SMOKE-PARTITIONS

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

3.11 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 096513
RESILIENT WALL BASE 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 wall base and accessories.
 - 2. Substrate preparation for resilient accessories.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 096800 - CARPETING for carpet accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of resilient wall base and accessories 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.
- C. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

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

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store tiles on flat surfaces.

1.6 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 RESILIENT WALL BASE

- A. Resilient Wall Base: ASTM F 1861.
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Flooring Products.
 - 3. Johnsonite, a division of Tarkett.
 - 4. Marley Flexco (USA), Inc.
 - 5. Nora Systems, Inc.
 - 6. Roppe Corporation.
- B. Style and Colors: As indicated on the Finish Schedule.
- C. Type (Material Requirement): TS (rubber, vulcanized thermoset) or TP (rubber, thermoplastic).
- D. Shape: Straight (toeless) at carpet and coved at resilient flooring.
- E. Minimum Thickness: 0.125 inch.
- F. Height: 4 inches.
- G. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
- H. Outside Corners: Premolded.
- I. Inside Corners: Premolded.
- J. Surface: Smooth.

2.2 RESILIENT MOLDING ACCESSORY

- A. 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. Burke Flooring Products.
 - 2. Endura
 - 3. Johnsonite, a division of Tarkett.
 - 4. Mondo Rubber International, Inc.
 - 5. Nora Systems, Inc.
 - 6. Roppe Corporation.
- B. Material: Rubber.
- C. Profile and Dimensions: As indicated.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
 - 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: 50 g/L.
 - b. Rubber Floor Adhesives: 60 g/L.
- C. 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.
- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT WALL BASE INSTALLATION

- A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

- D. Do not stretch wall base during installation.
- E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
- F. Premolded Corners: Install premolded corners before installing straight pieces.

3.4 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.

3.5 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. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
 - 2. 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 096800
CARPETING

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. Carpet tile.
 2. Carpet accessories.
 3. Substrate preparation for carpet and accessories.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 096513 - RESILIENT WALL BASE AND ACCESSORIES for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
1. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.
- B. Shop Drawings: Show the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 2. Carpet type, color, and dye lot.
 3. Seam locations, types, and methods.
 4. Type of subfloor.
 5. Type of installation.
 6. Pattern type, repeat size, location, direction, and starting point.
 7. Pile direction.
 8. Type, color, and location of insets and borders.
 9. Type, color, and location of edge, transition, and other accessory strips.
 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long Samples.

- D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.
- E. Sample Warranties: For special warranties.
- F. Maintenance Data: For carpet to include in maintenance manuals specified in Division 01. Include the following:
 - 1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 QUALITY ASSURANCE

- A. Carpeting Standard: Comply with the Carpet and Rug Institute's "CRI Carpet Installation Standard," 2011 edition, formerly CRI 104 "Standard For Installation Specification Of Commercial Carpet."
- B. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- C. Mockups: Before installing carpet, 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. General: Comply with CRI Carpet Installation Standard, Section 5, "Storage and Handling."
- B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

1.6 PROJECT CONDITIONS

- A. General: Comply with CRI Carpet Installation Standard, Section 7, "Site Conditions."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.
- D. Where demountable partitions, equipment, or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be

in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

- B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

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

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. InterfaceFLOR.
 - 2. Milliken & Co.
 - 3. Mannington Commercial.

2.2 CARPET

- A. Carpet Products: Subject to compliance with requirements, provide one of the following:
 - 1. Basis of Design: Milliken & Co.; OBEX Tile, Color: Grey.
 - 2. Other Acceptable Products:
 - a. InterfaceFLOR; Step Repeat Collection SR999, Color: 104945 Onyx.
 - b. Mannington Commercial; Frixtion Force, Color: Kinetic.
 - 3. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Product specific Type III EPD.
 - 4. Low-Emitting Materials, General Emissions Evaluation: Carpet and Rug Institute Green Label Plus.
 - 5. Do not permit polyvinyl chloride (PVC) or styrene butadiene rubber (SBR) carpet backing materials.
- B. Performance Characteristics:
 - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 - 2. Smoke Density: Not more than 450, when tested in accordance with ASTM E 662 or NFPA 258.
 - 3. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by carpet manufacturer.
 - 1. Low-Emitting Materials, General Emissions Evaluation: 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: Not more than 50 g/L.
 - 3. Methylene chloride and perchloroethylene may not be intentionally added to adhesives. Do not use adhesives that contain urea formaldehyde.
- C. Adhesive Film, for Carpet Tiles: Pressure sensitive adhesive, applied on one side of a polyester film, recommended by carpet tile manufacturer for releasable installation.
 - 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. InterfaceFLOR; TacTiles.
 - b. Shaw; LokDots Adhesive.
 - c. Tandus Centiva; TandusTape+

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
- B. Examine carpet for type, color, pattern, and potential defects.
- C. Concrete Subfloors: Comply with CRI Carpet Installation Standard, Section 9, "Testing Concrete Substrates." Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the carpet manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI Carpet Installation Standard, Section 7.3, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- 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. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Carpet Tile: Comply with CRI Carpet Installation Standard, Section 18, "Modular Carpet," and with carpet tile manufacturer's written installation instructions.
 1. Installation Method, for Adhesive: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.
 2. Installation Method, for Adhesive Film: Free lay; apply adhesive film squares at corners of tiles.
 - a. Do not install tiles with adhesive film at stair and ramp locations.
 - b. Do not install tiles with adhesive film over existing carpets.
 3. Installation Method, for No Adhesives: Free lay; press tiles firmly.
 - a. Do not install tiles without adhesive at stair and ramp locations.
 - b. Do not install tiles without adhesive over existing carpets.
 4. Carpet Tile Pattern: As directed by Architect.
 5. Maintain dye lot integrity. Do not mix dye lots in same area.
- B. Install pattern parallel to walls and borders.
- C. Do not bridge building expansion joints with carpet.

- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element and HEPA filter.
- B. Protect installed carpet to comply with CRI Carpet Installation Standard, Section 20, "Protecting Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION

SECTION 098610

GRAFFITI-RESISTANT COATING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- 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. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Sacrificial graffiti control coating on exposed wood surfaces.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, specifications, application instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

1.4 QUALITY ASSURANCE

- A. Applicator: Applicator shall be certified in writing as an approved applicator by the manufacturer of the materials to be used.
- B. Source: For each material type required for work of this Section, provide primary materials that are products of one manufacturer. Provide secondary or accessory materials that are acceptable to manufacturers of primary materials.
- C. Test Application: Prior to beginning primary work of this Section, provide test application mock-ups for each type of substrate material and condition to be coated at locations acceptable to Architect and obtain Architect's acceptance. Protect and maintain acceptable mock-ups throughout the work of this Section to serve as criteria for acceptance of this work.
 - 1. Provide sacrificial coating test mock-ups prior to beginning exterior production graffiti-proofing. Test various techniques and solutions to determine the best methods for the conditions encountered.
 - 2. Provide one 25 s.f. test application for each different method tested and for each different material that has to be graffiti-proofed.
 - 3. Demonstrate Contractor's quality control system to ensure uniform final appearance.
 - 4. Test adjacent non-graffiti-proofed surfaces for possible adverse reactions to graffiti-proofing methods.
 - 5. Use all tested products in strict compliance with the manufacturer's instructions and recommendations.

6. Keep accurate, detailed records of concentrations, solutions, and techniques used to assist in replicating satisfactory results.

1.5 PROJECT CONDITIONS

- A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.
 1. Materials shall be applied only when substrate surface temperature and ambient temperature is 50°F., and rising. Keep materials stored between 65°F. and 85°F. during application. Do not apply to substrate if materials exceed 85°F. in temperature.
 2. Avoid wind drift to adjacent surfaces.
 3. Divert and protect pedestrian and auto traffic adjacent to application. Remove spills and overspray immediately.
- B. Substrates: Proceed with work only when substrate construction and penetration work is complete.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Basis-of-Design: VandITop Sacrificial Graffiti Coating by Rain Guard or equal by PROSOCO or SEI Chemical.
 1. Use products recommended by Manufacturer for substrate indicated.
 2. Appearance: Clear, non-yellowing, low luster.
 3. Coverage: Approximately 250 sq.ft./gallon.
 4. Removal: Hot pressure wash.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine substrates, and conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 APPLICATION

- A. General Application Requirements: Strictly comply with manufacturer's instructions and approved submittals.

- B. Protection: Protect adjacent non-coated surfaces from coming in contact with solutions by using a strippable masking agent, plastic sheeting and waterproof tape, or another effective isolator approved by the Engineer and penetrating sealer manufacturer.
- C. Surface Preparation: All caulking, patching, and joint sealants shall be installed prior to application of penetrating sacrificial coating. Masonry surfaces shall be cleaned free of dust, surface dirt, efflorescence, contaminants, and membrane curing compounds.
 - 1. New work normally does not require cleaning; however, areas that have become heavily contaminated with surface dirt, oil, and the like, during construction, shall require thorough cleaning for best performance of the sacrificial coating.
 - 2. Masonry surfaces shall be power washed with high pressure water and appropriate chemical cleaners to remove contaminants that may have built up.
 - 3. Surfaces to be treated shall be dry and absorbent to assure good penetration of the sacrificial coating.

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 051200 - STRUCTURAL STEEL FRAMING for shop priming structural steel.
 2. Section 055000 - METAL FABRICATIONS for shop priming ferrous metal.
 3. Section 055100 - METAL STAIRS AND RAILINGS for shop priming ferrous metal.
 4. Section 081110 - HOLLOW METAL DOORS AND FRAMES for factory priming steel doors and frames.

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

- 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 four unopened gallons 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 the Finish Schedule on the Drawings.
- D. VOC Content for Interior Paints and Coatings: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L (SCAQMD and CARB).
2. Nonflat Paints and Coatings: 50 g/L (SCAQMD) or 100 g/L (CARB).
3. Nonflat, High Gloss Paints and Coatings: 50 g/L (SCAQMD) or 150 g/L (CARB).
4. Dry-Fog Coatings: 50 g/L (SCAQMD) or 150 g/L (CARB).
5. Primers, Sealers, and Undercoaters: 100 g/L.
6. Anticorrosive and Antirust Paints Applied to Ferrous Metals (Industrial Maintenance and Rust Preventative Coatings): 100 g/L (SCAQMD) or 250 g/L (CARB).
7. Zinc-Rich Industrial Maintenance Primers: 100 g/L (SCAQMD) or 340 g/L (CARB).
8. Pretreatment Wash Primers: 420 g/L.
9. Floor Coatings: 50 g/L (SCAQMD) or 100 g/L (CARB).
10. Shellacs, Clear: 730 g/L.
11. Shellacs, Pigmented: 550 g/L.
12. Clear Wood Finishes: 275 g/L.
13. Stains, Exterior: 100 g/L (SCAQMD) or 250 g/L (CARB).
14. Stains, Interior: 250 g/L.

- E. 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."

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 white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. 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 spar varnish.
 - 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 Concrete and Masonry (where indicated), Painted Finish:

a. One Coat:

- 1) Tnemec 156 Enviro-Crete at 6.0 to 10 mils DFT.
- 2) Liquid Plastics Acrylic at 8.0 to 10.0 mils DFT.
- 3) Dupont Tufcryl at 8.0 to 10.0 mils DFT.
- 4) RD Coatings Elasto-Flex at 6.0 to 10.0 mils DFT.

b. And One Coat:

- 1) Tnemec 156 Enviro-Crete at 8 to 10 mils DFT.
- 2) Liquid Plastics Acrylic at 8.0 to 10.0 mils DFT.
- 3) Dupont Tufcryl at 8.0 to 10.0 mils DFT.
- 4) RD Coatings Elasto-Flex at 6.0 to 10.0 mils DFT.

2. Exterior Galvanized Metal (not shop-finished under Section 051200 - STRUCTURAL STEEL FRAMING, Section 055000 - METAL FABRICATIONS, or Section 055100 - METAL STAIRS AND RAILINGS), Aliphatic Acrylic Polyurethane System:

a. Surface Preparation: SSPC-SP16 Brush-off Blast of Galvanized Steel.

b. One Coat:

- 1) Tnemec 66HS Hi-Build Epoxoline at 3.0 mils DFT.
- 2) PPG PMC Amerlock 400 Hi-Build Epoxy at 4.0-5.0 mils DFT.
- 3) Dupont 25P High Solids at 4.0 mils DFT.
- 4) International Intergard 475 HS at 5.0 to 10.0 mils DFT.

c. And One Coat:

- 1) Tnemec 73 Endura-Shield at 3.0 mils DFT.
- 2) PPG PMC Amercoat 450H Polyurethane at 3.0 mils DFT.
- 3) Dupont Imron 2.8 Urethane at 3.0 to 4.0 mils DFT.
- 4) International Interthane 990 HS at 3.0 to 4.0 mils DFT.

3. Exterior Ferrous Metal, Urethane System:

a. Surface Preparation: SSPC-SP6.

b. One Coat:

- 1) Tnemec 90G-1K97 at 3 mils DFT; shop applied under other Sections; use for touch up.
- 2) PPG PMC Amercoat 68 MCZ at 3 mils DFT; shop applied under other Sections; use for touch up.
- 3) Dupont Urethane Ganicin Zinc Rich Primer 80% zinc load at 3.0 mils DFT.
- 4) International Interzinc 315 at 2.0 to 3.0 mils DFT.

c. And One Coat:

- 1) Tnemec 66HS Hi-Build Epoxoline at 3.0 mils DFT.
- 2) PPG PMC Amerlock 400 Hi-Build Epoxy at 3.0 to 5.0 mils DFT.
- 3) Dupont 25P High Solids Epoxy at 4.0 to 6.0 mils DFT.
- 4) International Intergard 475 HS at 4.0 to 8.0 mils DFT.

d. And One Coat:

- 1) Tnemec 73 Endura-Shield at 3.0 mils DFT.
- 2) PPG PMC Amerlock 450H Polyurethane Topcoat at 3.0 mils DFT.
- 3) Dupont High Solids Imron Urethane at 4.0 mils DFT.
- 4) International Interthane 990 HS at 2.0 to 3.0 mils DFT.

C. Interior Paint Schedule, Typical:

1. Interior Gypsum Wallboard and Plaster, Latex Paint Finish:

a. One Coat, Primer:

- 1) Imperial Paints ECOS Interior Wall Primer.
- 2) Moore Ultra Spec 500 Interior Latex Primer 534.
- 3) PPG Speedhide Zero VOC Interior Primer 6-4900XI.
- 4) S-W Harmony Interior Primer B11 series.
- 5) S-W ProMar 200 HP Zero VOC Interior Primer.

b. And Two Coats, Flat Finish: At ceilings and elsewhere as indicated.

- 1) Imperial Paints ECOS Interior Flat.
- 2) Moore Ultra Spec 500 Interior Latex Flat 536.
- 3) PPG Speedhide Zero VOC Interior Latex Flat 6-4110XI.
- 4) S-W ProMar 400 Zero VOC Interior Flat.

c. And Two Coats, Eggshell Finish: At walls and elsewhere as indicated.

- 1) Imperial Paints ECOS Interior Eggshell.
- 2) Moore Ultra Spec 500 Interior Latex Low Sheen 537.
- 3) PPG Speedhide Zero VOC Interior Latex Eggshell 6-4310XI.
- 4) S-W ProMar 200 HP Zero VOC Interior Eg-Shel.

d. And Two Coats, Semi-Gloss Finish: At toilet rooms, other wet areas, and elsewhere as indicated.

- 1) Imperial Paints ECOS Interior Satin.
- 2) Moore Ultra Spec 500 Interior Latex Semi-Gloss 539.
- 3) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
- 4) S-W ProMar 200 HP Zero VOC Interior Semi-Gloss.

2. 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.

- b. And Two Coats:
 - 1) Moore Ultra Spec 500 Interior Latex Semi-Gloss 539.
 - 2) PPG Speedhide Zero VOC Interior Latex Semi-Gloss 6-4510XI.
 - 3) S-W ProMar 200 HP Zero VOC Interior Semi-Gloss.
- 3. Interior Exposed Steel, Joists, Ductwork, Conduit and Similar Items (where indicated), 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 at 2.5 to 3.0 mils DFT.
- 4. Interior Concrete Floor, Clear Exposed Sealer (Silicate type):
 - a. One Coat:
 - 1) Curecrete Chemical; Ashford Formula.
 - 2) Tnemec (Chem Probe); Series 629 CT Densifyer.
 - 3) WR Meadows; Liqui-Hard.
 - 4) Laticrete; L&M Seal Hard.
 - 5) Prosoco; Consolideck LS.
- 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 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.
 2. Aluminum panel signage.
 3. Exterior building signage.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 055000 - METAL FABRICATIONS for aluminum panel signage supports.
 2. 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 Americans with Disabilities Act (ADA), Amtrak Signage Manual, Department of Transportation Americans with Disabilities Act (ADA) Standards for Transportation Facilities 2006, 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. Type Size: As selected.
- d. 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. Type Size: As selected.
- d. Typeface: As selected.

3. Exterior Signs:

- a. Type – Wall: Fabricated stainless-steel letters and non-illuminated.

- b. Aluminum Panel Signage: Fabricated monolithic aluminum sign with masked and painted graphics.
 - 1) See Section 055000 - METAL FABRICATIONS for framing and supports.
 - 2) Configuration: As indicated on 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 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. Fire-protection cabinets for portable fire extinguishers.
 3. 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.
 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- 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.

- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

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.
 - 1. Rated for use in unconditioned space including sub-freezing temperatures.

2.2 FIRE-PROTECTION CABINET

- 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. JL Industries, Inc.
 - 2. Larsen's Manufacturing Company.
 - 3. Nystrom Building Products.
 - 4. Potter Roemer; Div. of Smith Industries, Inc.
- B. Cabinet Type: Suitable for fire extinguisher.
- C. Cabinet Material: Stainless steel sheet.
- D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 - 1. Trimless with Plaster Stop: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop. If wall condition does not allow for trimless with plaster stop, provide flat 5/16 inch trim of same material as the cabinet box.
- E. Surface Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- F. Door Material: Stainless steel sheet with baked enamel finish, color as selected.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered glass.

- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

2.3 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.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.

- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated on the Drawings and acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. Identification: Apply vinyl lettering at locations indicated.

3.4 INSTALLATION OF FIRE-RATED CABINETS

- A. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
- B. Seal through penetrations with firestopping sealant as specified in Section 078410 - PENETRATION FIRESTOPPING.

3.5 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.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 124810
ENTRANCE FLOOR MATS 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. Roll-up aluminum-tread rail floor mats with aluminum hinges.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for concrete work, including forming, placing, and finishing concrete floor slabs, and for concrete materials for grouting and filling around and under recessed mats and frames.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show the following:
 - 1. Items penetrating floor mats and frames, including door control devices.
 - 2. Divisions between mat sections.
 - 3. Perimeter floor moldings.
- C. Samples for Verification: For each type of product indicated.
 - 1. Floor Mat: 12-inch- square, assembled sections of floor mat.
 - 2. Frame Members: 12-inch- long Sample of each type and color.
- D. Maintenance Data: For floor mat and frames to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

- B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)", and Department of Transportation Americans with Disabilities Act (ADA) Standards for Transportation Facilities 2006.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

1.6 COORDINATION

- A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

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. Roll-up Aluminum Rail Hinged Mats:
 - a. AFCO-USA.
 - b. Balco, Inc.
 - c. Construction Specialties, Inc.
 - d. Mats Inc.
 - e. Nystrom.

2.2 METAL FRAME MATERIALS

- A. Extruded Aluminum: ASTM B 221 alloy 6061-T6 or alloy 6063-T5, T6, or T52 as standard with manufacturer.

2.3 CONCRETE FILL AND GROUT MATERIALS

- A. Provide concrete materials complying with Section 033000 - CAST-IN-PLACE CONCRETE for grout and fill around and under recessed mats and frames that produce concrete equivalent in strength to cast-in-place concrete slabs. For concrete fill, adjust aggregate size to not exceed one-third fill thickness.

2.4 FLOOR MATS

- A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. If not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's standards.
- B. Roll-up Aluminum Rail Hinged Mats: Clear-anodized finish, extruded-aluminum tread rails sitting on continuous vinyl cushions with 1-1/2-inch-wide by 3/8-inch-thick, tread rail modules.

Provide aluminum hinges and 28-oz./sq. yd. weight, level-cut, nylon-pile, fusion-bonded carpet tread inserts.

1. Tapered Rigid Frame: Tapered extruded-aluminum frame members, not less than 1-1/2 inches wide, with mitered corners and finish to match tread-slat extrusions.
- C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated.
1. 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."
 2. VOC Content: 50 g/L or less.
 3. Do not use adhesives that contain urea formaldehyde.
 4. Methylene chloride and perchloroethylene may not be intentionally added to adhesives and sealants.

2.5 FABRICATION

- A. General: Where possible, verify sizes by field measurement before shop fabrication.
- B. Floor Mats: Shop fabricate units to greatest extent possible in sizes as indicated. If not otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- C. Recessed Metal Mat Frames: Extruded aluminum of size and style to fit floor mat type specified, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
 1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- D. With manufacturer's standard protective coating, coat surfaces of aluminum frames that will contact cementitious material.

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. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
 - 1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
 - 2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.
- B. Defer installation of floor mats until Project is near Substantial Completion.

END OF SECTION

SECTION 142100
ELECTRIC TRACTION ELEVATORS

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. Machine-room-less electric traction passenger elevators.

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

1. Section 033000 - CAST-IN-PLACE CONCRETE for lintels, sleeves, anchors, inserts, plates and similar items for elevators.
2. Section 051200 - STRUCTURAL STEEL FRAMING for the hoist beams, attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
3. Section 055000 - METAL FABRICATIONS for miscellaneous framing and supports for hoisting machines, and for elevator door sills, cants in hoistways made from sheet steel, and elevator pit ladders.
4. Division 09 - FINISHES for floor finish requirements.
5. Division 26 - ELECTRICAL for telephone service to elevators.
6. Division 26 - ELECTRICAL for electrical service for elevators to and including disconnect switches at machine room door and telephone wiring to elevator.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

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

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:
2. Car enclosures and hoistway entrances.

3. Operation, control, and signal systems.

- B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, equipment layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.
- D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- E. Qualification Data: For Installer.
- F. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- G. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- H. Warranty: Special warranty specified in this Section.
- I. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain elevators through one source from a single manufacturer.
 - 1. Provide major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.
- C. Regulatory Requirements: Comply with ASME A17.1.
- D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG), and Department of Transportation Americans with Disabilities Act (ADA) Standards for Transportation Facilities 2006.
- E. Fire-Rated Hoistway Entrance Assemblies: Door and frame 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, based on testing at as close to neutral pressure as possible according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging.
- B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

- A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.
- B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.
- C. Coordinate locations and dimensions of other work relating to traction elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.
 - 1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 1. Include 24-hour-per-day, 7-day-per-week emergency callback service.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering electric traction elevators that may be incorporated into the Work include, but are not limited to, the following:

1. KONE Inc.; MonoSpace 300 DX.
2. Otis Elevator Co.; Gen3 Edge.
3. ThyssenKrupp Elevator; Evolution 200.

2.2 PASSENGER ELEVATORS

A. Elevators:

1. Type: Machine-room-less (MRL), gearless traction.
2. Rated Load: 3500 lb.
3. Rated Speed: 150 fpm.
4. Auxiliary Operations:
 - a. Battery-powered lowering.
 - b. Nuisance call cancel.
5. Car Enclosures: As follows:
 - a. Inside Width: As indicated on the Drawings.
 - b. Inside Depth: As indicated on the Drawings.
 - c. Inside Height: As indicated on the Drawings.
 - d. Front Walls: Satin stainless steel with integral car door frames.
 - e. Car Fixtures: Satin stainless steel.
 - f. Side and Rear Wall Panels: Satin stainless steel.
 - g. Reveals: Satin stainless steel.
 - h. Door Faces (Interior): Satin stainless steel.
 - i. Door Sills: Aluminum.
 - j. Ceiling: Satin stainless steel, with LED downlights.
 - k. Handrails: Satin stainless steel, at side and rear walls.
 - l. Floor prepared to receive carpeting as specified in Section 096800.
6. Hoistway Entrances: As follows:
 - a. Final configuration to comply with approved Shop Drawings.
 - b. Width: As indicated on the Drawings.
 - c. Height: As indicated on the Drawings.
 - d. Type: Single-speed side sliding.
 - e. Frames: Satin stainless steel.
 - f. Doors: Satin stainless steel.
 - g. Sills: Aluminum.
7. Hall Fixtures: Satin stainless steel.
8. Additional Requirements: As follows:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
 - b. Provide protective blanket hooks in all cars and two complete sets of full-height blankets.
9. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Type III EPD.

2.3 SYSTEMS AND COMPONENTS

- A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.
- B. Elevator Machines: Provide variable-voltage, variable-frequency, ac-type or variable-voltage, dc-type hoisting machines. Provide solid-state power converters.
 - 1. Provide regenerative or nonregenerative system.
 - 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 - 3. Provide means for absorbing regenerated power when elevator system is operating on standby power.
 - 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- C. Fluid for Oil Buffers: If oil buffers are used, use only fire-resistant hydraulic fluid containing antioxidant, anticorrosive, antifoaming, and metal-passivating additives.
 - 1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Hydro Safe (FR)" by Hydro Safe Oil Division, Inc.
- D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.
- E. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Division 05 Section "Metal Fabrications" for materials and fabrication.
- F. Car Frame and Platform: Welded steel units.
- G. Guides: Provide roller guides or polymer-coated, nonlubricated sliding guides at top and bottom of car and counterweight frames.

2.4 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.
- B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 - 1. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
- C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
 - 1. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.5 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

2.6 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, satin (No. 4) finish.
 - 1. Textured Stainless-Steel Sheet: Product with embossed texture rolled into exposed surface.
- E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304, satin (No. 4) finish.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- G. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or No. C77600.
- H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

2.7 CAR ENCLOSURES

- A. General: Provide enameled-steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
 - 2. Provide finished car including materials and finishes specified below.
- B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:
 - 1. Subfloor: Underlayment grade, exterior plywood, 5/8-inch nominal thickness.
 - 2. Fabricate car with recesses and cutouts for signal equipment.
 - 3. Fabricate car door frame integrally with front wall of car.
 - 4. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 - 5. Sight Guards: Provide sight guards on car doors.
 - 6. Sills: Extruded nickel silver, with grooved surface, 1/4 inch thick.
 - 7. Handrails: Manufacturer's standard handrails meeting code requirements, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

- A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.
- B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:
1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 2. Sight Guards: Provide sight guards on doors matching door edges.
 3. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
 4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.
- B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.
- C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 26 - ELECTRICAL.
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.
 1. Include travel direction arrows if not provided in car control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide[one of] the following:
 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 1. At manufacturer's option, audible signals may be placed on each car.
- I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Examine hoistways, hoistway openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
 - 1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to minimize transmission of vibrations to structure and thereby minimize structure-borne noise from elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and direction of travel.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - 2. Place hall lanterns either above or beside each hoistway entrance.
 - 3. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator.
- B. Check operation of each elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION

SECTION 22 05 00

BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- E. Scope of Work:
 - 1. Plumbing Work shall include, but is not necessarily limited to:
 - a. Furnish and install all items listed in the Plumbing Material List.
 - b. Furnish and install sump pump, discharge piping and valves.
 - c. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
 - d. Complete all applicable tests, certifications, forms, and matrices.
 - 2. Heating Work: Refer to Section 23 05 00 "Basic HVAC Requirements".
 - 3. Air Conditioning and Ventilating Work: Refer to Section 23 05 00 "Basic HVAC Requirements".
 - 4. Temperature Control Work: Refer to Section 23 05 00 "Basic HVAC Requirements".
 - 5. Fire Protection Work: Refer to Section 21 05 00 "Basic Fire Suppression Requirements".
 - 6. Testing, Adjusting, and Balancing Work: Refer to Section 23 05 00 "Basic HVAC Requirements".

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

- A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

| Distribution/Nominal Voltage | Utilization Voltage |
|------------------------------|---------------------|
| 120 | 115 |
| 208 | 200 |
| 240 | 230 |
| 277 | 265 |
| 480 | 460 |

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Boiler Feed Pumps.
 - b. Burners.
 - c. Chillers.
 - d. Computer Room Air Conditioning Units.
 - e. Condensate Return Stations.
 - f. Condensing Units.
 - g. Makeup Air Units.
 - h. Electric Humidifiers.
 - i. Gas Trains.
 - j. Package Air Handling Units.
 - k. Packaged Rooftop Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control [Subcontractor][Contractor] when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the [Mechanical Contractor]<Insert>.ol style="list-style-type: none;"> - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as sewer and water.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing **Revit**.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

| Referenced Specification | Submittal Item |
|--------------------------|-----------------------|
| Section | |
| 22 05 00 | Owner Training Agenda |
| 22 05 03 | Fire Seal Systems |

| Referenced Specification Section | Submittal Item |
|-------------------------------------|------------------------------------|
| 22 05 29 | Hangers and Supports |
| 22 10 00 | Plumbing Piping Systems and Valves |
| 22 14 29 | Sump Pumps |

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:

- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
- 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 - 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 - 9. Reproduction of contract documents alone is not acceptable for submittals.
 - 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 - 11. Submittals not required by the contract documents may be returned without review.
 - 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 - 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 - 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 22 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.7 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:

- a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
- a. Excavation and backfill for underground piping systems inside the building.
 - b. Underground piping systems inside the building (sanitary, storm, etc.) listed separately. Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
 - c. Each aboveground piping system (sanitary, storm, domestic water, etc.). Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
 - d. Pipe insulation with separate material and labor line items for each piping system listed above.
 - e. Each piece of equipment requiring shop drawings (e.g., backflow preventer, water heater, water softener, etc.) using the project nomenclature (BFP-1, WH-1, WS-1, etc.).
 - f. Each plumbing fixture (e.g., WC, lavatory, sink, etc.). Multiple units of the same type can be listed together, provided quantities are also listed so unit costs can be determined.
 - g. Site utilities (5' beyond building)
 - h. Seismic design
 - i. Water balancing
 - j. Commissioning
 - k. Record drawings
 - l. Punchlist and closeout
- D. Update Schedule of Values when:
- 1. Indicated by Architect/Engineer.
 - 2. Change of subcontractor or supplier occurs.
 - 3. Change of product or equipment occurs.

1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.9 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Fire Seal Systems
 2. Seismic Restraints and Equipment Bracing
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.11 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.12 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.13 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.14 CONTINGENCY

- A. Include in the Base Bid a contingency of <Insert> percent to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.15 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first manufacturer is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

1.16 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section [01 91 00][and][22 08 00] and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
1. Placing fill over underground and underslab utilities.
 2. Covering exterior walls, interior partitions and chases.
 3. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including [marked-up][or][reproducible] drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to [project site][and place in location as directed]; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div22.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, <Insert> paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.
16. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. The instructions shall include:
 1. Explanation of all system flow diagrams.
 2. Maintenance of equipment.
 3. Start-up procedures for all major equipment.
 4. Explanation of seasonal system changes.
 5. Explanation of Owner's Responsibilities to operate, maintain, and flush domestic water system (i.e., ASHRAE Standard 188).
- F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.
- G. Minimum hours of instruction for each item shall be:
 1. Domestic Hot Water System - <Insert> hours
 2. All Domestic Water Systems operation, maintenance and flushing of all fixtures and dead legs - <Insert> hours
 3. Domestic Water Pressure Booster System - <Insert> hours.
 4. Water Softener, Filtration and/or Purification System - <Insert> hours
 5. Domestic Water Supplemental Treatment System - <Insert> hours
 6. Medical Gas System(s) - <Insert> hours.
- H. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of **[two][four]** weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- I. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.

2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

- A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of plumbing drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- D. Before completion of the project, a set of reproducible plumbing drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

- E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- F. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.10 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
 - 1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 - d. Protect stored on-site and installed absorptive materials from moisture damage.
 - 2. Request that the Owner designate an IAQ representative.
 - 3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.

4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
6. Request copies of and follow all of the Owner's IAQ and infection control policies.
7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.
5. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

END OF SECTION

SECTION 22 05 03

THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

- A. UL 263 - Fire Tests of Building Construction and Materials.
- B. UL 723 - Surface Burning Characteristics of Building Materials.
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops.
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ).
- F. Intertek / Warnock Hersey - Directory of Listed Products.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
- I. The Building Officials and Code Administrators National Building Code.
- J. 1997 Uniform Building Code.
- K. International Building Code.
- L. NFPA 5000 - Building Construction Safety Code.
- M. HCAI - Health Care Access and Information (California).

1.4 SUBMITTALS

- A. Submit under provisions of [Division 1][Section 22 05 00].
- B. Submit Firestopping Installers Certification for all installers on the project.

- C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.
- D. 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.
 - 4. F ratings for each firestop system.
- E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq. ft at both ambient temperature and 400°F for smoke barriers.
- C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the [Construction Manager][General Contractor], all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

- A. Provide one year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
 - 1. 3M; Fire Protection Products Division.
 - 2. Hilti, Inc.
 - 3. RectorSeal Corporation, Metacaulk.
 - 4. Tremco; Sealant/Weatherproofing Division.
 - 5. Johns-Manville.
 - 6. Specified Technologies Inc. (S.T.I.)
 - 7. Spec Seal Firestop Products
 - 8. AD Firebarrier Protection Systems
 - 9. Dow Corning Corp.
 - 10. Fire Trak Corp.
 - 11. International Protective Coating Corp.

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated:

- a. F Rating = Floor/Wall Rating
- b. L Rating = Penetrations in Smoke Barriers

| Penetrating Item | UL System No. |
|--|---------------|
| No Penetrating Item | FC 0000-0999* |
| Metallic Pipe or Conduit | FC 1000-1999 |
| Non-Metallic Pipe or Conduit | FC 2000-2999 |
| Electrical Cables | FC 3000-3999 |
| Cable Trays | FC 4000-4999 |
| Insulated Pipes | FC 5000-5999 |
| Bus Duct and Misc. Electrical | FC 6000-6999 |
| Duct without Damper and Misc. Mechanical | FC 7000-7999 |
| Multiple Penetrations | FC 8000-8999 |

*Alternate method of firestopping is patching opening to match original rated construction.

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated:

- a. F Rating = Floor/Wall Rating
- b. L Rating = Penetrations in Smoke Barriers

| Penetrating Item | UL System No. |
|--|---------------|
| No Penetrating Item | WL 0000-0999* |
| Metallic Pipe or Conduit | WL 1000-1999 |
| Non-Metallic Pipe or Conduit | WL 2000-2999 |
| Electrical Cables | WL 3000-3999 |
| Cable Trays | WL 4000-4999 |
| Insulated Pipes | WL 5000-5999 |
| Bus Duct and Misc. Electrical | WL 6000-6999 |
| Duct without Damper and Misc. Mechanical | WL 7000-7999 |
| Multiple Penetrations | WL 8000-8999 |

| Penetrating Item | UL System No. |
|---|---------------|
| *Alternate method of firestopping is patching opening to match original rated construction. | |

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated:

- a. F Rating = Wall/Floor Rating
- b. L Rating = Penetrations in Smoke Barriers

| Penetrating Item | UL System No. |
|---|----------------|
| No Penetrating Item | CAJ 0000-0999* |
| Metallic Pipe or Conduit | CAJ 1000-1999 |
| Non-Metallic Pipe or Conduit | CAJ 2000-2999 |
| Electrical Cables | CAJ 3000-3999 |
| Cable Trays | CAJ 4000-4999 |
| Insulated Pipes | CAJ 5000-5999 |
| Bus Duct and Misc. Electrical | CAJ 6000-6999 |
| Duct without Damper and Misc. Mechanical | CAJ 7000-7999 |
| Multiple Penetrations | CAJ 8000-8999 |
| *Alternate method of firestopping is patching opening to match original rated construction. | |

- H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean 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 cause damage.
- 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, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

- A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
 - 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the engineer and manufacturer's factory representative. The engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 22 05 29

PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 REFERENCES

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- D. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 22 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

- A. Refer to Section 22 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

| Pipe Size | Hanger Rod Diameter | |
|--------------------|---------------------|-----------|
| | Column #1 | Column #2 |
| 2-1/2" and smaller | 3/8" | 3/8" |
| 3" through 3-5/8" | 3/8" | 3/8" |
| 4" and 5" | 1/2" | 1/2" |
| 6" | 3/4" | 5/8" |
| 8" through 12" | 7/8" | 3/4" |
| 14" | 1" | 7/8" |
| 16" and 18" | 1" | N/A |
| 20" and 24" | 1-1/4" | N/A |

Column #1: Steel, cast iron, and glass pipe.

Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

2.3 PIPE AND STRUCTURAL SUPPORTS

- A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.
3. Copper piping located in an exposed area, including indirect waste piping in **[kitchens][and][janitor's closets]**, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.
 - a. Products:
 - 1) Erico/M-Co Model #456
 - 2) B-Line Fig. 3198HCT
 - 3) Anvil Fig. CT138R
 - 4) Nibco/Tolco Fig. 301CT

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.
 - a. Products:
 - 1) Cooper/B-Line Fig B3373 Series
 - 2) Erico 510 Series
 - 3) Nibco/Tolco Fig. 82
2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.
 - a. Products:
 - 1) Mason RBA, RCA or RDA
 - 2) Mason BR
3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.
 - a. Products:
 - 1) Pipeshields E100
4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.
3. Vertical cold pipe drops and rough-ins to fixtures shall be supported by insulated pipe clamps to prevent thermal bridging and condensation.
4. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

5. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
 - a. Products:
 - 1) Anvil Fig. 160, 161, 162, 163, 164, 165
 - 2) Cooper/B-Line Fig. 3160, 3161, 3162, 3163, 3164, 3165.
 - 3) Erico Model 630, 631, 632, 633, 634, 635.
 - 4) Nibco/Tolco Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

6. Unless otherwise indicated, hangers shall be as follows:
 - a. Clevis Type:
 - 1) Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches & Smaller
 - 2) Products: Bare Steel Plastic or Insulated Pipe:
 - a) Anvil Fig. 260
 - b) Cooper/B-Line Fig. 3100
 - c) Erico Model 400
 - d) Nibco/Tolco Fig. 1
 - 3) Products: Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3100C
 - b) Nibco/Tolco Fig. 81PVC
 - b. Roller Type:
 - 1) Service: Insulated Hot Pipe - 4 inches and Larger
 - 2) Products: 4" through 6":
 - a) Anvil Fig. 181, 271
 - b) Cooper/B-Line Fig. 3110, 3117
 - c) Erico Model 610
 - d) Nibco/Tolco Fig. 324, 327
 - 3) Products: 8" and Above:
 - a) Anvil Fig. 171, 271
 - b) Cooper/B-Line Fig. 3114, 3117
 - c) Erico Model 605
 - d) Nibco/Tolco Fig. 322, 327
 - c. Padded Clevis Type:
 - 1) Service: Glass Pipe
 - 2) Hangers:
 - a) Anvil Fig. 260
 - b) Cooper/B-Line Fig. 3100

- c) Erico Model 400
 - d) Nibco/Tolco Fig. 11
 - 3) Pads:
 - a) Anvil Fig. 3195
 - d. Continuous Channel with Clevis Type: Service: Plastic Tubing, Flexible Hose, Soft Copper Tubing:
 - 1) Products:
 - a) Cooper/B-Line Fig. B3106, with Fig. B3106V
 - b) Erico Model 104, with Model 104V
 - c) Nibco/Tolco Fig. 1V
 - e. Adjustable Swivel Ring Type:
 - 1) Service: Bare Metal Pipe - 4 inches and Smaller
 - 2) Bare Steel Pipe:
 - a) Anvil Fig. 69
 - b) Cooper/B-Line Fig. B3170NF
 - c) Erico Model FCN
 - d) Nibco/Tolco Fig. 200
 - 3) Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3170CTC
 - b) Erico 102A0 Series
 - c) Nibco/Tolco Fig. 203
7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
- a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
 - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
- a. Clamp Type:
 - 1) Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller
 - 2) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

- 3) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
 - 4) Bare Steel, Plastic or Insulated Pipe:
 - a) Unistrut Fig. P1100 or P2500
 - b) Cooper/B-Line Fig. B2000 or B2400
 - c) Nibco/Tolco Fig. A-14 or 2STR
 - 5) Bare Copper Pipe:
 - a) Cooper/B-Line Fig. BVT
- b. Roller Type:
- 1) Service: Insulated Hot Pipe - 4 inches and larger.
 - 2) Products: 4" through 6":
 - a) Unistrut Fig. P2474
 - b) Cooper/B-Line Fig. B218
 - c) Nibco/Tolco Fig. ROL-12
 - 3) Products: 8" and Above:
 - a) Unistrut Fig. P2474-1
 - b) Cooper/B-Line Fig. B219
 - c) Nibco/Tolco Fig. ROL-13

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
 - a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):
 - 1) Products:
 - a) Anvil Fig. 92
 - b) Cooper/B-Line Fig. B3033/B3034
 - c) Erico Model 300
 - d) Nibco/Tolco 68
 - b. Steel Structure Clamps: Scissor Type Beam Clamps (for use with bar-joists and wide flange):
 - 1) Products:
 - a) Anvil Fig. 228, 292
 - b) Cooper/B-Line Fig. B3054
 - c) Erico Model 360
 - d) Nibco/Tolco Fig. 329

- c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):
 - 1) Products:
 - a) MCL. M1, M2 or M3
- d. Concrete: Concrete Inserts, Single Rod Galvanized:
 - 1) Products:
 - a) Anvil Fig. 282
 - b) Cooper/B-Line Fig. B3014
 - c) Erico Model 355
 - d) Nibco/Tolco Fig. 310
- e. Concrete: Concrete Inserts, Continuous Strip Galvanized:
 - 1) Products:
 - a) Unistrut Corp P3200 Series
 - b) Cooper/B-Line Fig. B22-J
 - c) Erico CONCT
- f. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-[05]. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
- g. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- h. Steel Structure Welding:
 - 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.
- i. Wood Anchors: Tension wood rod hanger for suspending 3/8" threaded rod. Zinc plated carbon steel.
 - 1) Minimum allowable tension loads for Douglass Fir/Southern Pine:
 - a) 3/8" diameter rod; 2-1/2" shank: 600 lb/590 lb.
 - b) Load values are based on full shank penetration into wood member. Minimum edge distance 3/4". Minimum end distance 3-1/4".
 - 2) Limitations:
 - a) Truss: Do not hang from wood trusses without truss manufacturer or Structural Engineer's approval.
 - b) Sheetrock/Gypsum Ceiling: When drilling through non-wood materials (e.g., sheet rock, gypsum, etc.), increase shank length by depth of non-wood materials.

- c) Plywood Flooring/Roofing: Do not hang from plywood floor or roofing.
- d) Spacing: Refer to wood structure spacing of hangers.

3) Products:

- a) Simpson RWV
- b) DeWALT
- c) ITI Sammys GT25

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 22 05 50 for additional requirements for concrete bases in seismic applications.
2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).
3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
5. Equipment requiring bases is as follows:
 - a. Expansion Tank
 - b. Day Tank
 - c. Heat Exchanger
 - d. Pump
 - e. Tank
 - f. Water Heater
 - g. Water Softener

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.
- F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150°F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.6 ROOF PENETRATIONS

- A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe penetrations. Refer to drawings for details.
- B. Conical Pipe Boot: Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color: [White][Black]<Insert> shall match roofing membrane.
- C. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas.

- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
 - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
 - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120°F, sleeves may be thermoplastic with integral water seal and textured surface.
 - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
 - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
 - 5. Sealing element shall be as follows:

| Model | Service | Element Material | Temperature Range |
|-------|------------------------------|---------------------|-------------------|
| S | Standard (Stainless) | EPDM | -40°F to 250°F |
| T | High/Low Temperature (Steam) | Silicone | -67°F to 400°F |
| T | Fire Seals (1 hour) | Silicone | -67°F to 400°F |
| FS | Fire Seals (3 hours) | Silicone | -67°F to 400°F |
| OS | Oil Resistant/Stainless | Nitrile | -40°F to 210°F |

- 6. Manufacturers:
 - a. Thunderline Corporation "Link-Seals"
 - b. O-Z/Gedney Company
 - c. Calpico, Inc.
 - d. Innerlynx
 - e. Metraflex Company (cold service only)

2.8 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
 - 4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
 - 1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
 - 2. Set all concrete inserts in place before pouring concrete.
 - 3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
 - 4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
 - 5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"

- 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" & larger: 12'-0"
2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" and under: 9'-0"
 - 2) 1-1/2": 12'-0"
 - 3) 2" & larger: 12'-0"
3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"
4. Hard Drawn Copper & Brass (Vapor Service):
 - a. Maximum Spacing:
 - 1) 3/4" & under: 7'-0"
 - 2) 1": 8'-0"
 - 3) 1-1/4": 9'-0"
 - 4) 1-1/2": 10'-0"
 - 5) 2": 11'-0"
 - 6) 2-1/2" & larger: 12'-0"
5. Plastic Pipe:
 - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
6. Ultra-Flexible Pipe, and Flexible Hose, and Soft Copper Tubing:
 - a. Continuous channel with hangers maximum 8'-0" OC.

I. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):

a. Maximum Spacing:

- 1) 1-1/4" & under: 7'-0"
- 2) 1-1/2": 9'-0"
- 3) 2": 10'-0"
- 4) 2-1/2": 11'-0"
- 5) 3": 12'-0"
- 6) 4" through 6": 12'-0"
- 7) 8": 9'-0"
- 8) 10": 6'-0"
- 9) 12": 4'-0"

2. Steel (Std. Weight or Heavier - Vapor Service):

a. Maximum Spacing:

- 1) 1-1/4" and under: 9'-0"
- 2) 1-1/2": 12'-0"
- 3) 2" & larger: 12'-0"
- 4) 2-1/2": 11'-0"
- 5) 3": 12'-0"
- 6) 4" through 8": 12'-0"
- 7) 10": 9'-0"
- 8) 12": 6'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

a. Maximum Spacing:

- 1) 3/4" and under: 5'-0"
- 2) 1": 6'-0"
- 3) 1-1/4": 7'-0"
- 4) 1-1/2" 8'-0"
- 5) 2": 8'-0"
- 6) 2-1/2": 9'-0"
- 7) 3": 10'-0"
- 8) 4": 12'-0"
- 9) 6": 12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

a. Maximum Spacing:

- 1) 3/4" & under: 7'-0"
- 2) 1": 8'-0"
- 3) 1-1/4": 9'-0"
- 4) 1-1/2": 10'-0"
- 5) 2": 11'-0"

- 6) 2-1/2" & larger: 12'-0"
- 5. Plastic Pipe:
 - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
- 6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
 - a. Continuous channel with hangers maximum 8'-0" OC.
- J. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
 - 1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" through 6": 12'-0"
 - 7) 8": 9'-0"
 - 8) 10": 6'-0"
 - 9) 12": 4'-0"
 - 2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1/2" and under: 6'-0"
 - 2) 3/4" to 1": 8'-0"
 - 3) 1-1/4" and under: 9'-0"
 - 4) 1-1/2": 10'-0"
 - 5) 2" & larger: 10'-0"
 - 6) 3": 12'-0"
 - 7) 4" through 8": 12'-0"
 - 8) 10": 9'-0"
 - 9) 12": 6'-0"
 - 3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" & under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 6'-0"
 - 4) 1-1/2": 6'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"

- 8) 4": 10'-0"
 - 9) 6": 10'-0"
 - 4. Hard Drawn Copper & Brass (Vapor Service):
 - a. Maximum Spacing:
 - 1) 3/4" & under: 6'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 6'-0"
 - 4) 1-1/2": 6'-0"
 - 5) 2": 10'-0"
 - 6) 2-1/2" & larger: 10'-0"
 - 5. Plastic Pipe:
 - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
 - 6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
 - a. Continuous channel with hangers maximum 8'-0" OC.
- K. Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.

END OF SECTION

SECTION 22 10 00
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Check Valves.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.
- E. Pipe hangers and supports shall be spaced per 2019 CPC, Table 313.3, as applied to each pipe system listed. Refer to Section 22 05 29 for hanger and support components. Seismic supports shall be submitted as a deferred approval using OPM guidelines. Shop drawings shall be submitted for review to the AHJ: State, local or agency reviewing the project, DSA, HCAI. Upon approval, these shop drawings shall be included in the record set.
- F. Potable water piping and fittings shall comply with California Assembly Bill AB1953 limiting lead content. Also described in 2019 CPC: 604.2 Lead Content.
- G. Valves for potable water systems shall comply with California Assembly Bill AB1953 limiting lead content. Also described in 2019 CPC: 604.2 Lead Content.
- H. Hubless clamps shall meet FM 1680 for HCAI 1, 2 and 3.

1.3 REFERENCES

- A. ANSI/ASME A112.3.1 - Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.
- B. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
- C. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- G. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- H. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- I. ANSI/ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- J. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- K. ANSI/ASTM B32 - Solder Metal.
- L. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- M. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- N. ANSI/AWS D1.1 - Structural Welding Code.
- O. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
- P. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- Q. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- R. ANSI/AWWA C153 - Compact Ductile Iron Fittings 3" through 48", for Water and Other Liquids.
- S. ASME - Boiler and Pressure Vessel Code.
- T. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- U. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- V. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.
- W. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- X. ASTM A312 - Standard for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- Y. ASTM A554 - Standard for Welded Stainless Steel Mechanical Tubing.
- Z. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
- AA. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.

- BB. ASTM B88 - Seamless Copper Water Tube.
- CC. ASTM B306 - Copper Drainage Tube (DWV).
- DD. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- EE. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- FF. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- GG. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- HH. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- II. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- JJ. ASTM D2661 - ABS DWV Pipe & Fittings.
- KK. ASTM D2665 - PVC DWV Pipe & Fittings.
- LL. ASTM D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
- MM. ASTM D3033 - Type PSP (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
- NN. ASTM D3034 - Type PSM (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
- OO. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
- PP. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- QQ. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- RR. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.
- SS. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- TT. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- UU. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- VV. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
- WW. AWS A5.8 - Brazed Filler Metal.

- XX. AWWA C651 - Disinfecting Water Mains.
- YY. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- ZZ. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- AAA. FM 1680 - Couplings Used in Hubless Cast Iron Systems.
- BBB. NFPA 24 - Private Fire Service Mains and Their Appurtenances.
- CCC. NFPA 54 - National Fuel Gas Code.
- DDD. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
- EEE. NSF - National Sanitation Foundation
- FFF. HCAI - Health Care Access and Information (California)
- GGG. CCR - California Code of Regulation
- HHH. CBC - California Building Code
- III. CPC - California Plumbing Code

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

1.5 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COPPER PIPE

- A. Copper Pipe; Type K; Solder Joints:
 - 1. Pipe: Type K hard drawn seamless copper tube, ASTM B88.
 - 2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
 - 3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
 - 4. Fittings: Wrought copper solder joint, ANSI B16.22.
- B. Copper Pipe; Type K; Mechanically Coupled Grooved Joints:
 - 1. Pipe: Type K hard drawn seamless copper tube, ASTM B88, roll grooved per mechanical coupling manufacturers specifications.
 - 2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
 - 3. Joints: Mechanically coupled grooved type.

4. Mechanical Couplings: Ductile iron, ASTM A-536, (Grade 65-45-12), rigid grooved type, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633
5. Gaskets: Molded pressure responsive design, EPDM Grade E, ASTM D-2000, suitable for domestic water with temperatures ranging from 32°F to 230°F.
6. Fittings: Copper, ASTM B-75 and ANSI B-16.22, Full flow wrought copper, manufactured by mechanical coupling manufacturer
7. Flanges: Grooved end type, Ductile iron, ASTM A-536, (Grade 65-45-12), Flange shall conform to ANSI Class 125 cast iron and Class 150 steel flange bolt hole pattern, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633.
8. Manufacturers:
 - a. Gruvlok
 - b. Victaulic
 - c. Grinnell
 - d. Shurjoint

C. Copper Pipe: Type DWV; Solder Joints:

1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.
2. Design Pressure: Gravity Maximum Design Temperature: 180°F
3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
4. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

2.2 GALVANIZED STEEL PIPE

A. Galvanized Steel; Standard Weight; Mechanically Coupled Grooved Joints

1. Pipe: Galvanized; standard weight galvanized steel, ASTM A53, grooved ends or threaded and coupled.
2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
3. Joints: Mechanically coupled grooved type or screwed.
4. Mechanical Couplings: Malleable iron, ASTM A97, Grade 32510, grooved type.
5. Fittings: Malleable iron, ASTM A47, Grade 32510, galvanized with grooved ends or 125# steam - 175# CWP, galvanized cast iron, ASTM A126, ANSI B16.4.
6. Flanges: Grooved end, galvanized flanged adapter nipples, Gustin Bacon No. 54, Victaulic No. 54 or 125# steam - 175# CWP, galvanized cast iron, screwed, ASTM A126, Grade B, ANSI B16.1, with galvanized or cadmium plated bolting.
7. Manufacturers:
 - a. Gruvlok
 - b. Victaulic
 - c. Grinnell
 - d. Shurjoint

B. Galvanized Steel; Standard Weight; Threaded Joints:

1. Pipe: Galvanized; standard weight galvanized steel, ASTM A53, threaded and coupled.
2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
3. Joints: screwed.
4. Fittings: Malleable iron, ASTM A47, Grade 32510, galvanized with grooved ends or 125# steam - 175# CWP, galvanized cast iron, ASTM A126, ANSI B16.4.

5. Flanges: Grooved end, galvanized flanged adapter nipples, Gustin Bacon No. 54, Victaulic No. 54 or 125# steam - 175# CWP, galvanized cast iron, screwed, ASTM A126, Grade B, ANSI B16.1, with galvanized or cadmium plated bolting.

2.3 PLASTIC PIPE

1. PVC Pressure Pipe; Schedule 40/SDR26; Solvent Weld - Pressure Pipe: Pipe: PVC pipe, Schedule 40 Solvent weld fittings, ASTM D1785. Cellular core piping is not acceptable.
2. Joints: Solvent Weld.
3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
4. Use: Use PVC only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.4 VALVES

A. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
2. Gate Valves:
 - a. GA-1: 2" and under, 150# steam @ 406°F, 300# CWP @ 150°F, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, Nibco T-131.
 - b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi CWP @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, Nibco F-617-0.
 - c. GA-7: 2-1/2" thru 12", 200# CWP @ 150°F, flanged, iron body, bronze trim, OS&Y. Crane #475-1/2, Hammond #IR1146, Stockham #G624, Walworth #8727F, Milwaukee #F2891, Nibco F-617-0.
 - d. GA-12: 2-1/2" thru 12", 200# CWP, hub ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-5, Kennedy #56.
 - e. GA-13: 2" thru 12", 200# CWP, mechanical joint ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-20, Kennedy #571X.
3. Ball Valves:
 - a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.
 - 1) Provide solid extended shaft for all insulated piping.

- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
- b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Stockham #3951-CS-R-66-LL, Nibco #F510-CS/66, Milwaukee #F90.
 - 1) Provide extended shaft for all valves in insulated piping.
 - 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
 - c. BA-9: 2" and under, 150 psi saturated steam, 600 psi CWP, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-255-FB-P-UL, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.
 - 1) Provide solid extended shaft for all valves in insulated piping.
 - d. BA-11: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. A.Y. McDonald 6100 Series, Mueller 300 Series.
 - e. BA-12: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. Minneapolis Pattern threaded top. A.Y. McDonald 6100 Series, Mueller 300 Series.

B. Throttling Valves

2.5 CHECK VALVES

- A. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.
- B. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.
- C. CK-6: 2-1/2" thru 12", 125# steam @ 450°F, 200# CWP @ 150°F, flanged, all iron, horizontal swing. Crane #373-1/2, Hammond #IR1126, Stockham #G933, Walworth #8928-1/2F, Milwaukee #F-2971, Watts #F-511-R, Nibco F-918N.
- D. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG-970 BUNA, NIBCO W-920-W, Crane.

- E. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

2.6 CONNECTIONS BETWEEN DISSIMILAR METALS

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel and stainless steel are commonly used and require isolation from each other with the following exceptions:
 - 1. Iron and steel connected to each other.
 - 2. Brass, copper, and bronze connected to each other.
 - 3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
 - 1. Dielectric waterway rated for 300 psi CWP and 225°F.
 - 2. Manufacturers:
 - a. Elster Group ClearFlow fittings
 - b. Victaulic Series 647
 - c. Grinnell Series 407
 - d. Matco-Norca
- F. Flanged Joints (any size):
 - 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
 - 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
 - 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
 - 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
 - 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
 - 6. Manufacturers:
 - a. EPCO

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- E. Connect to equipment with flanges or unions.
- F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.
- G. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 SYSTEM, PIPING AND VALVE SCHEDULE

- A. Storm - Pumped (Above Ground - Inside Building):
 - 1. Copper Pipe; Type K; Solder Joints: All Sizes
 - 2. Galvanized Steel; Standard Weight; Threaded Joints: 4" and under
 - 3. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes
 - 4. Check Valves: CK-1, CK-13

3.3 CLEANING PIPING

- A. Assembly:
 - 1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
 - 2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.
 - 3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.
 - 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.
- B. Air Blow:

1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.
2. Air blow applies to the following systems:
 - a. Acetylene
 - b. Carbon Dioxide
 - c. Nitrogen (use oil free air or nitrogen gas)
 - d. Argon (use oil free air or nitrogen gas)
 - e. Instrument Air (use oil free air or nitrogen gas)
 - f. Distilled Water (use maximum of 50 psig pressure)
 - g. Chemical Feed
 - h. Air Compressor Intakes
 - i. Sulfuric Acid (use oil free air or nitrogen gas)

C. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

D. Fire Service:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:
 - a. 390 gpm for 4" pipes.
 - b. 880 gpm for 6" pipes.
 - c. 1560 gpm for 8" pipes.
 - d. 2440 gpm for 10" pipes.
 - e. 3500 gpm for 12" pipes.

3.4 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.
- B. Installation Requirements in Electrical Rooms:
1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.
- C. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):
1. All piping in MRI rooms shall be non-ferrous regardless of materials described on Part 2.
- D. Valves/Fittings and Accessories:
1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.
 2. Provide clearance for installation of insulation and access to valves and fittings.
 3. Provide access doors for concealed valves and fittings.
 4. Install valve stems upright or horizontal, not inverted.
 5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
 6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- E. Underground Piping:
1. Install buried water piping outside the building with at least 5 feet of cover. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements
 3. Install buried borosilicate glass pipe with the protective polystyrene covering intact. Lay the pipe on bedding and backfill per manufacturer instructions.
 4. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24.
 5. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.
 6. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
 7. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy Kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.
 - a. Manufacturers:
 - 1) Pipe Line Service Co., Franklin Park, Illinois
 - 2) Lithcote Corp., Melrose Park, Illinois

8. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.
 - a. Manufacturers:
 - 1) Republic Steel Corp. "X-Tru-Coat"
9. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.
10. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.
11. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.
12. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

F. Sanitary and Storm Piping:

1. Install all sanitary and storm piping inside the building with a slope as shown on the drawings.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 2 feet per second.
4. Sway Bracing: Where horizontal sanitary and/or storm pipes 4 inches and larger change flow direction greater than 45°, rigid bracing or thrust restraints shall be installed to resist movement of the upstream pipe in the direction of pipe flow. The rigid bracing or thrust restraint shall be connected to structure. A change of flow direction from horizontal into a vertical pipe does not require the upstream pipe to be braced.
5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
6. Starter fittings with internal baffles are not permitted.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.
- N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2" limestone.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- E. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- F. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- G. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.

- C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.
- D. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.
- E. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- F. In no case shall the vent through the roof be less than 4" in diameter.
- G. Vent pipes through the roof shall be located a minimum of 10 feet from any air intake opening on the roof.

3.8 JOINING OF PIPE

A. Threaded Joints (Galvanized Steel Pipe):

- 1. Threads shall conform to ANSI B2.1 "Pipe Threads".
- 2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
- 3. Protect plated pipe and valve bodies from wrench marks when making up joints.
- 4. Apply thread lubricant to male threads as follows:
 - a. Vents and Roof Conductors: Red graphite
 - b. All Other Services: Teflon tape

B. Flanged Joints (Galvanized Steel Pipe):

- 1. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
- 2. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180° apart are torqued in sequence.
- 3. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Solder Joints (Copper Pipe):

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.

D. Mechanically Coupled Grooved Joints (Copper and Galvanized Steel Pipe):

1. Grooved connections shall mechanically engage, lock, and seal the grooved pipe ends in a positive couple. Each coupling shall have malleable iron housing clamps, steel bolts and nuts, and sealing gasket designed so internal pressure increases the tightness of the seal. Couplings must be installation-ready style for quick installation and no more than two-piece housings.
2. All work, including pipe grooving, shall be accomplished in accordance with manufacturer's published instructions.
3. Final tightening of bolts shall be with a torque wrench to ensure equal tension in all bolts. Torque shall be in accordance with manufacturers published instructions.
4. All fittings shall be provided by one manufacturer. Mixing grooved components are not acceptable.
5. Product Warranty:
 - a. Standard: One-year product warranty. A factory-trained manufacturer's representative shall visit the site for contractor training and installation observation.
 - 1) On-site Training: Manufacturer's factory trained representative shall provide training of contractor's field personnel in use of grooving tools and installation of product. Documentation of installing contractor training with manufacturer's representative shall be submitted to the Architect/Engineer.
 - 2) Job Site Visitation: Manufacturer's representative shall periodically visit job site to ensure manufacturer's installation practices are being followed.
 - b. Extended 5-Year Product Warranty: Manufacturer shall provide extended 5-year warranty to replace product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.
 - c. Extended 5-Year Product and Installation Warranty: Manufacturer shall provide extended 5-year warranty to replace product and any part of the system damaged as a direct result of a failure of the product. Warranty shall include onsite training and inspection of all fittings by manufacturer. Manufacturer inspection report shall be provided to the Owner upon completion.

E. Solvent Weld Joints (CPVC):

1. If a primer is required by the Authority Having Jurisdiction, then a primer conforming to ASTM F656 shall be used.

3.9 SERVICE CONNECTIONS

- A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sump Pumps.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.
- D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- E. Submit certification that pumps, accessories, and components will withstand seismic forces defined in Section 22 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- F. Manufacturer shall provide special seismic certification per HCAI CAN 2-1708a.5 with submittal. Submittals without certification will be returned and not reviewed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.

- C. Pumps shall operate at 1750 rpm unless specified otherwise.
- D. Pump connections shall be flanged, whenever available.
- E. Motors shall comply with Section 22 05 13.
- F. The discharge pipe sizes shall meet or exceed the scheduled pump.

2.2 SUMP PUMPS

- A. Provide pumps as specified on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings and accessories.
- C. Support piping so weight of piping is not supported by pumps.
- D. Mount control panel on adjacent wall within required distance for cables and wiring. Provide unistrut mounting frame for the control panel if wall space is not available. Properly anchor frame to floor.
- E. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
- F. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Architect/Engineer, manufacturer shall provide a factory trained representative to field align the shafts.
- G. Sump pumps that discharge to storm shall be installed with the top of the sump basin 2" above floor level. A 2" high x 4" wide concrete curb around the perimeter of the basin lid may be used in lieu of raising the entire sump basin.
- H. Set submersible sump pumps on basin/pit floor. Make direct connections to storm drainage piping.
- I. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

END OF SECTION

SECTION 23 0500 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. Separate contracts will be awarded for the following work:
- D. Scope of Work:
 - 1. Heating Work shall include, but is not necessarily limited to:
 - a. Terminal heat transfer unit and all associated controls.
 - b. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
 - 2. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
 - a. Furnish and install complete hoistway ventilation systems including all fittings, louvers, dampers, actuators, and controls.
 - b. Furnish and install complete split systems including all insulated refrigerant piping, condensate piping, supports, and controls.
 - c. Furnish and install all temperature control systems.
 - d. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
 - 3. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing including, but not limited to, air systems, hydronic systems,, and verification of control systems.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

- A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Heating Contractor.
 - b. Air Conditioning and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

| Distribution/Nominal Voltage | Utilization Voltage |
|------------------------------|---------------------|
| 120 | 115 |
| 208 | 200 |
| 240 | 230 |
| 277 | 265 |
| 480 | 460 |

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Cabinet Unit Heaters.
2. Assumes all responsibility for the Temperature Control wiring when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

4. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" (40 mm) and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" (40 mm) and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.

- e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
 2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
 3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.
- B. Participation:
1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.
- C. Drawing Requirements:
1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Maine Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.6 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

| Referenced Specification Section | Submittal Item |
|-------------------------------------|--|
| 23 05 00 | Owner Training Agenda |
| 23 81 26 | Split Systems, Piping, Pipe Insulation |
| 23 82 00 | Terminal Heat Transfer Equipment |

- B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:
1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
 3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

- b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
- 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 - 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 - 9. Reproduction of contract documents alone is not acceptable for submittals.
 - 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 - 11. Submittals not required by the contract documents may be returned without review.
 - 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 - 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 - 14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 23 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:
 1. Motor windings.
 2. Bearings.
 3. Pipe connections.
 4. Duct connections.
 5. Starter and control cabinets.
 6. Heat transfer coil fins.

- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.9 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.10 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.12 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.

- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
 - 1. Covering exterior walls, interior partitions and chases.
 - 2. Installing hard or suspended ceilings and soffits.

- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
 - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe and duct wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
 - d. Main, branch and flexible ducts are installed.
 - e. Diffusers, registers and grilles are installed and connected to ductwork.
 - f. Terminal air box reheat coil piping or wiring is complete.
 - g. Terminal air box control wiring is complete and all control boxes are closed.
 - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
 - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 01.
- B. Final Jobsite Observation:
 - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
 - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
 - 3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
 - 4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.
- C. Before final payment is authorized, this Contractor must submit the following:
 - 1. Operation and maintenance manuals with copies of approved shop drawings.
 - 2. Record documents including marked-up or reproducible drawings and specifications.
 - 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Inspection by State Boiler Inspector.
5. Start-up reports on all equipment requiring a factory installation inspection or start-up.
6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 23 0900 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.
8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.
10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The instructions shall include:
 1. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 2. Maintenance of equipment.
- E. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.
- F. Minimum hours of instruction for each item shall be:
 1. Temperature Controls - As defined in Section 23 0900.

- G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- H. Operating Instructions:
 - 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
 - 2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels.
- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- D. Refer to Section 23 0900 for additional requirements for Temperature Control documents.

3.8 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.10 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 - d. Protect stored on-site and installed absorptive materials from moisture damage.
2. Request that the Owner designate an IAQ representative.
3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
6. Request copies of and follow all of the Owner's IAQ and infection control policies.
7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".
10. If permanently installed air handlers are used to serve both construction and occupied areas, all return grilles throughout construction areas shall be sealed to prevent air from construction areas being supplied to occupied areas.
11. If permanently installed air handlers are used during construction to serve only construction areas and do not supply air to adjacent occupied areas, MERV 8 filtration media shall be used to protect each return air grille or opening. The intent of this will be to prevent construction dust and debris from entering any return or supply air ductwork in the facility. All filtration media shall be replaced immediately prior to occupancy.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. All fans shall be operating and balanced.
2. All miscellaneous mechanical systems (terminal heating equipment, split systems, dampers) operating.
3. All temperature control systems operating, programmed and calibrated.
4. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 23 05 29

HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 REFERENCES

- A. ANSI/ASME B31.1 - Power Piping.
- B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- E. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

- A. Refer to Section 23 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

| Pipe Size | Hanger Rod Diameter | |
|--------------------|---------------------|-----------|
| | Column #1 | Column #2 |
| 2-1/2" and smaller | 3/8" | 3/8" |
| 3" through 3-5/8" | 3/8" | 3/8" |
| 4" and 5" | 1/2" | 1/2" |
| 6" | 3/4" | 5/8" |
| 8" through 12" | 7/8" | 3/4" |
| 14" | 1" | 7/8" |
| 16" and 18" | 1" | N/A |
| 20" and 24" | 1-1/4" | N/A |

Column #1: Steel pipe.

Column #2: Copper, plastic and fiberglass reinforced pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

2.3 PIPE AND STRUCTURAL SUPPORTS

- A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

- B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

- a. Products:

- 1) Cooper/B-Line Fig B3373 Series
 - 2) Erico 510 Series
 - 3) Nibco/Tolco Fig. 82
2. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.

3. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.
3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
4. Unless otherwise indicated, hangers shall be as follows:
 - a. Clevis Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and Smaller:
 - 1) Products: Bare Steel, Plastic or Insulated Pipe:
 - a) Anvil Fig. 260
 - b) Cooper/B-Line Fig. 3100
 - c) Erico Model 400
 - d) Nibco/Tolco Fig. 1
 - 2) Products: Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3100C
 - b) Nibco/Tolco Fig. 81PVC
 - b. Roller Type: Service: Insulated Hot Pipe - 4 inches and Larger:
 - 1) Products: 4" through 6":
 - a) Anvil Fig. 181, 271
 - b) Cooper/B-Line Fig. 3110, 3117
 - c) Erico Model 610
 - d) Nibco/Tolco Fig. 324, 327
 - 2) Products: 8" and Above:
 - a) Anvil Fig. 171, 271
 - b) Cooper/B-Line Fig. 3114, 3117
 - c) Erico Model 605
 - d) Nibco/Tolco Fig. 322, 327
 - c. Continuous Channel with Clevis Type: Service: Plastic Tubing, Flexible Hose, Soft Copper Tubing:
 - 1) Products:
 - a) Cooper/B-Line Fig. B3106, with Fig. B3106V

- b) Erico Model 104, with Model 104V
 - c) Nibco/Tolco Fig. 1V
 - d. Adjustable Swivel Ring Type: Service: Bare Metal Pipe - 4 inches and Smaller:
 - 1) Products: Bare Steel Pipe:
 - a) Anvil Fig. 69
 - b) Cooper/B-Line Fig. B3170NF
 - c) Erico Model FCN
 - d) Nibco/Tolco Fig. 200.
 - 2) Products: Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3170CTC
 - b) Erico 102A0 Series
 - c) Nibco/Tolco Fig. 203
- 5. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
 - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
 - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
- 6. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
 - a. Clamp Type: Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller:
 - 1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.
 - 2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
 - 3) Products: Bare Steel, Plastic or Insulated Pipe:
 - a) Unistrut Fig. P1100 or P2500
 - b) Cooper/B-Line Fig. B2000 or B2400
 - c) Nibco/Tolco Fig. A-14 or 2STR
 - 4) Products: Bare Copper Pipe:
 - a) Cooper/B-Line Fig. BVT

b. Roller Type: Service: Insulated Hot Pipe - 4 inches and larger:

1) Products: 4" through 6":

- a) Unistrut Fig. P2474
- b) Cooper/B-Line Fig. B218
- c) Nibco/Tolco Fig. ROL-12

2) Products: 8" and Above:

- a) Unistrut Fig. P2474-1
- b) Cooper/B-Line Fig. B219
- c) Nibco/Tolco Fig. ROL-13

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):

1) Products:

- a) Anvil Fig. 92
- b) Cooper/B-Line Fig. B3033/B3034
- c) Erico Model 300
- d) Nibco/Tolco 68

b. Scissor Type Beam Clamps (for use with bar-joists and wide flange):

1) Products:

- a) Anvil Fig. 228, 292
- b) Cooper/B-Line Fig. B3054
- c) Erico Model 360
- d) Nibco/Tolco Fig. 329

c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):

1) Products:

- a) MCL. M1, M2 or M3

d. Concrete: Inserts Single Rod Galvanized:

1) Products:

- a) Anvil Fig. 282
- b) Cooper/B-Line Fig. B3014
- c) Erico Model 355
- d) Nibco/Tolco Fig. 310

- e. Concrete: Inserts Continuous Strip Galvanized:
 - 1) Products:
 - a) Unistrut Corp P3200 Series
 - b) Cooper/B-Line Fig. B22-J
 - c) Erico CONCT
- f. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-[05]. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
- g. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- h. Steel Structure Welding:
 - 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.
- i. Wood Anchors: Tension wood rod hanger for suspending 3/8" threaded rod. Zinc plated carbon steel.
 - 1) Minimum allowable tension loads for Douglass Fir/Southern Pine:
 - a) 3/8" diameter rod; 2-1/2" shank: 600 lb/590 lb.
 - b) Load values are based on full shank penetration into wood member. Minimum edge distance 3/4". Minimum end distance 3-1/4".
 - 2) Limitations:
 - a) Truss: Do not hang from wood trusses without truss manufacturer or Structural Engineer's approval.
 - b) Sheetrock/Gypsum Ceiling: When drilling through non-wood materials (e.g., sheet rock, gypsum, etc.), increase shank length by depth of non-wood materials.
 - c) Plywood Flooring/Roofing: Do not hang from plywood floor or roofing.
 - d) Spacing: Refer to wood structure spacing of hangers.
 - 3) Products:
 - a) Simpson RWV
 - b) DeWALT
 - c) ITI Sammys GT25

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.
- F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150°F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.6 ROOF PENETRATIONS

- A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for[pipe][and][duct] penetrations. Refer to drawings for details.
- B. Conical Pipe Boot: Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color: [White][Black]<Insert> shall match roofing material.
- C. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
 - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
 - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120°F, sleeves may be thermoplastic with integral water seal and textured surface.
 - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
 - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
 - 5. Sealing element shall be as follows:

| Model | Service | Element Material | Temperature Range |
|-------|------------------------------|---------------------|-------------------|
| S | Standard (Stainless) | EPDM | -40°F to 250°F |
| T | High/Low Temperature (Steam) | Silicone | -67°F to 400°F |
| T | Fire Seals (1 hour) | Silicone | -67°F to 400°F |
| FS | Fire Seals (3 hours) | Silicone | -67°F to 400°F |
| OS | Oil Resistant/Stainless | Nitrile | -40°F to 210°F |

- 6. Manufacturers:
 - a. Thunderline Corporation "Link-Seals"
 - b. O-Z/Gedney Company
 - c. Calpico, Inc.
 - d. Innerlynx
 - e. Metraflex Company (cold service only)

2.8 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
 - 1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" & larger: 12'-0"
 - 2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" and under: 9'-0"
 - 2) 1-1/2": 12'-0"
 - 3) 2" & larger: 12'-0"
 - 3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"
 - 4. Hard Drawn Copper & Brass (Vapor Service):
 - a. Maximum Spacing:
 - 1) 3/4" & under: 7'-0"
 - 2) 1": 8'-0"
 - 3) 1-1/4": 9'-0"
 - 4) 1-1/2": 10'-0"
 - 5) 2": 11'-0"
 - 6) 2-1/2" & larger: 12'-0"

5. Plastic Pipe:
 - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
 6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
 - a. Continuous channel with hangers maximum 8'-0" OC.
- I. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" through 6": 12'-0" 8": 9'-0" 10": 6'-0" 12": 4'-0"
 2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" and under: 9'-0"
 - 2) 1-1/2": 12'-0"
 - 3) 2" & larger: 12'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" through 8": 12'-0"
 - 7) 10": 9'-0"
 - 8) 12": 6'-0"
 3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"
 4. Hard Drawn Copper & Brass (Vapor Service):
 - a. Maximum Spacing:

- 1) 3/4" & under: 7'-0"
- 2) 1": 8'-0"
- 3) 1-1/4": 9'-0"
- 4) 1-1/2": 10'-0"
- 5) 2": 11'-0"
- 6) 2-1/2" & larger: 12'-0"

5. Plastic Pipe:

- a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:

- a. Continuous channel with hangers maximum 8'-0" OC.

J. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):

a. Maximum Spacing:

- 1) 1-1/4" & under: 7'-0"
- 2) 1-1/2": 9'-0"
- 3) 2": 10'-0"
- 4) 2-1/2": 11'-0"
- 5) 3": 12'-0"
- 6) 4" through 6": 12'-0" 8": 9'-0" 10": 6'-0" 12": 4'-0"

2. Steel (Std. Weight or Heavier - Vapor Service):

a. Maximum Spacing:

- 1) 1/2" and under: 6'-0"
- 2) 3/4" to 1": 8'-0"
- 3) 1-1/4" and under: 9'-0"
- 4) 1-1/2": 10'-0"
- 5) 2" & larger: 10'-0"
- 6) 3": 12'-0"
- 7) 4" through 8": 12'-0"
- 8) 10": 9'-0"
- 9) 12": 6'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

a. Maximum Spacing:

- 1) 3/4" & under: 5'-0"
- 2) 1": 6'-0"
- 3) 1-1/4": 6'-0"
- 4) 1-1/2": 6'-0"
- 5) 2": 8'-0"

- 6) 2-1/2": 9'-0"
- 7) 3": 10'-0"
- 8) 4": 10'-0"
- 9) 6": 10'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

a. Maximum Spacing:

- 1) 3/4" & under: 6'-0"
- 2) 1": 6'-0"
- 3) 1-1/4": 6'-0"
- 4) 1-1/2": 6'-0"
- 5) 2": 10'-0"
- 6) 2-1/2" & larger: 10'-0"

5. Plastic Pipe:

- a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

6. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:

- a. Continuous channel with hangers maximum 8'-0" OC.

K. Installation of hangers shall conform to MSS SP-58, 69, and 89.

END OF SECTION

SECTION 23 05 53

HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

1.2 REFERENCES

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM B-1, B-3, and B-8 for copper conductors.
- C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 - 2kV Cables.
- D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
- E. NFPA-99 - Health Care Facilities.
- F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.
- B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 3M.
- B. Bunting.
- C. Calpico.
- D. Craftmark.
- E. Emedco.
- F. Kolbi Industries.

- G. Seton.
- H. W.H. Brady.
- I. Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

| OD of Pipe or Insulation | Marker Length | Size of Letters |
|----------------------------|---------------|-----------------|
| Up to and including 1-1/4" | 8" | 1/2" |
| 1-1/2" to 2" | 8" | 3/4" |
| 2-1/2" to 6" | 12" | 1-1/4" |
| 8" to 10" | 24" | 2-1/2" |
| Over 10" | 32" | 3-1/2" |

Plastic tags may be used for outside diameters under 3/4"

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
- H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.
- I. Ductwork Markers:
 - 1. Ductwork systems containing hazardous materials shall be provided with minimum 2" x 4" ANSI Z535.2 biohazard warning labels with custom labeling describing hazard. Refer to Part 3 for system and label description.
 - 2. Vinyl Markers: Colored vinyl with permanent pressure sensitive adhesive backing suitable for indoor and outdoor application.
- J. Ceiling Markers:
 - 1. Label Style:

- a. The intent is for the ceiling labels to be inconspicuous but easy to find and read while standing underneath. The labels shall be located on the grid T-bar nearest the ceiling tile that can be removed to provide the best access to the serviceable side of equipment or to valves. An arrow can be used to point to the tile needing removal.
 - b. The label tape shall be approximately 1/2" wide with all capitalized letters approximately 3/16" tall.
 - c. Ceiling grid labels shall be made with a label maker with durable adhesive labels having a clear background and black letters.
 - d. Equipment labels shall be as designated on the drawings (e.g., FCU-606B, etc.).
 - e. Valve labels shall be designated by the size, service, and the valve tag number (e.g., 1-1/4" CW #123, 2" HWS #234, etc.). A single longer label can be used to identify multiple valves using spaces between the descriptors if the valves are located close together and have the same service (e.g., HWS and HWR valves serving the same equipment or CW, HW, and HWC lines serving the same restroom, etc.).
 - f. Fire, fire/smoke and smoke dampers shall be labeled consistent with the type (e.g., Fire Damper, Fire/Smoke Damper, etc.).
2. "Dot" Style:
- a. The intent is for the ceiling labels to be inconspicuous but easy to find and read while standing underneath. The labels shall be located on the grid T-bar nearest the ceiling tile that can be removed to provide the best access to the serviceable side of equipment or to valves.
 - b. The marker shall be a self-adhesive color dot approximately 1/2" in diameter.
 - c. The equipment and accessories to be marked and dot color shall be coordinated with the Architect/Engineer and Owner.
 - 1) Equipment and accessories to be marked:
 - a) Hydronic Valves
 - b) Fire Dampers
 - c) Fire/Smoke and Smoke Dampers
 - d) Fan Coil Units
 - e) Project Specific Item

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 1. All valves (except shutoff valves at equipment) shall have numbered tags.
 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
6. Number all tags and show the service of the pipe.
7. Provide two sets of laminated 8-1/2" x 11" (letter size) copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Stencil Painted Pipe Markers:
 - a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
 - b. Apply primer on non-insulated pipes before painting.
 - c. Use background and letter colors as scheduled later in this section.
4. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.
5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Ductwork Markers:

1. Apply ductwork markers on ductwork systems containing hazardous materials in the following locations where clearly visible:
 - a. On both sides of walls that ducts penetrate.
 - b. At least every 20 feet along all ducts.
 - c. On each riser and each leg of each branch connection.
 - d. At least once in every room and each story traversed.
 - e. At all ductwork access doors.
 - f. At all fans and equipment serving ductwork system. Markers shall be clearly visible from the normal maintenance access path to the equipment. Coordinate placement location with Owner.

F. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

G. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

3.2 SCHEDULE

- A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:
1. CONDENSATE DRAIN: White lettering; green background
 2. REFRIGERANT LIQUID: White lettering; purple background
 3. REFRIGERANT SUCTION: White lettering; purple background

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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. 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.

1.3 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
- C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- D. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.

- J. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- K. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- L. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- M. ASTM E84 - Surface Burning Characteristics of Building Materials.
- N. NFPA 255 - Surface Burning Characteristics of Building Materials.
- O. UL 723 - Surface Burning Characteristics of Building Materials.
- P. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
- B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.
- C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.29 maximum 'K' value at 75°F; density 7.3lb/ft; minimum compressive strength 90 psi parallel to rise; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose polymer or polypropylene service jacket for above grade installations.
- D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.
- E. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75°F; density 4.0lb/ft; minimum compressive strength 95 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -297°F to +300°F.
- F. Type F: Phenolic insulation; ASTM C1126; maximum 'K' value of 0.22 at 75°F; density 3.75lb/ft; minimum compressive strength 50 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -290°F to +250°F.
- G. Type G: Granular Inorganic Powder; non-toxic; non-flammable; totally free of asbestos; 0.65 maximum 'K' value at 40 lb./cu ft density and 300°F; treated to resist moisture. Suitable from 35°F to 800°F.

- H. Type H: Semi-Rigid Mineral Wool Fiberboard; ANSI/ASTM C612; 0.30 maximum 'K' value at 200°F. Suitable to 1200°F.
- I. Type I: Rigid Mineral Fiber Blocks; ANSI/ASTM C612; 0.625 maximum 'K' value at 800°F. Suitable for 1900°F.
- J. Type J: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'K' value at 300°F. 3.0 lb./cu ft density. Suitable for 850°F.
- K. Type K: Preformed rigid extruded polystyrene (Styrofoam); ANSI/ASTM C578; maximum 'K' value of 0.259 at 75°F aged 180 days; moisture resistant; suitable for -297°F to +165°F.
- L. Type L: High performance aerogel; ANSI/ASTM C1728; 0.19 maximum 'K' value at 345°F; non-combustible. Flexible hydrophobic aerogel blanket. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

2.2 VAPOR BARRIER JACKETS

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.
- B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

3.2 INSTALLATION

- A. General Installation Requirements:
 1. Install materials per manufacturer's instructions, building codes and industry standards.
 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
 3. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has been listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested as a composite in accordance with ASTM E84 or UL 723.
 4. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
3. All balance valves and strainers with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow access for reading and adjusting of the balancing valve and cleaning and servicing of the balancing valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.
2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Refrigerant Piping:

1. On refrigerant piping (25°F and above) and not required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360°, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.

F. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 SUPPORT PROTECTION

- A. Provide a shield on all insulated piping at each support between the insulation jacket and the support.

- B. On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:
1. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
 - a. Molded hydrous calcium silicate (only use for pipes with operating temperatures above 90°F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - b. Polyisocyanurate insulation (for pipes below 300°F with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3" and below, minimum 60 psi for pipe sizes 4" to 10". For pipe sizes larger than 10", provide rolled steel plate in addition to the shield. Where insulation is installed on piping located within return air plenums and mechanical rooms, insulation shall be listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
 - c. Cellular glass (for all temperature ranges) with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - d. Phenolic (for pipes operating below 250°F with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - e. As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
 - 1) Products:
 - a) Buckaroo CoolDry
 - b) Cooper/B-Line Fig. B3380 through B3384
 - c) Pipe Shields A1000, A2000
 - f. Insulation Couplings:
 - 1) Molded thermoplastic slip coupling, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
 - 2) Horizontal Strut Mounted Insulated Pipe Manufacturers:
 - a) Klo-Shure or equal
 - 3) Vertical Manufacturers:
 - a) Manufacturers: Klo-Shure Titan or equal
 - g. Rectangular blocks, plugs, or wood material are not acceptable.
 - h. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

- C. Neatly finish insulation at supports, protrusions, and interruptions.
- D. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
- E. Shields shall be at least the following lengths and gauges:

| Pipe Size | Shield Size |
|----------------|---------------------|
| 1/2" to 3-1/2" | 12" long x 18 gauge |
| 4" | 12" long x 16 gauge |
| 5" to 6" | 18" long x 16 gauge |
| 8" to 14" | 24" long x 14 gauge |
| 16" to 24" | 24" long x 12 gauge |

- F. Ferrous hot piping 4 inches and larger, provide steel saddle at rollers as described in Section 23 05 29 "HVAC Supports and Anchors".
- G. Minimum 1/4" rolled galvanized steel plates shall be provided in addition to the sleeves as reinforcement on large pipes to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength. Refer to section above for exact locations.

3.4 INSULATION

- A. Type A Insulation:
 1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
 2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
 3. Apply insulation with laps on top of pipe.
 4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.
- B. Type B Insulation:
 1. Install per manufacturer's instructions or ASTM C1710.
 2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
 3. Insulation Installation on Straight Pipes and Tubes:
 - 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 must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
- 4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- C. Type C Insulation:
 - 1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.
 - 2. Insulate fittings with prefabricated fittings.
- D. Type D Insulation:
 - 1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
 - 2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.
- E. Type E Insulation:
 - 1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
 - 2. Insulate pipe fittings with prefabricated insulation fittings.
- F. Type F Insulation:
 - 1. Seal all longitudinal joints with manufacturer approved adhesive or mastic. Secure butt joint strips in a similar manner.
 - 2. Indoors, above grade or below grade, polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
 - 3. Insulate pipe fittings with prefabricated insulation fittings.
- G. Type G Insulation:
 - 1. Outdoor and Indoor, Underground: Compact insulation per manufacturer's requirements to allow insulation to act as pipe bedding. Install padding at expansion loops or elbows.
 - 2. Manufacturer's representative shall visit site and approve installation procedures.
 - 3. Thickness listed is nominal. Follow manufacturer's guidelines for actual dimensions.
- H. Type H, I, and J Insulation:
 - 1. Apply with edges tightly butted, joints broken.

2. Secure with 16 gauge galvanized, annealed steel wire or 1/2" x 0.015" galvanized steel bands, 12" maximum centers.
3. Install welding studs, clips and angles where required to anchor wires and bands.

I. Type K Insulation:

1. Indoors, above grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
2. Insulate fittings with prefabricated fittings.

J. Type L Insulation:

1. Aerogel Blanket: Apply in multiple layers. Either a butt joint or lap joint is acceptable for the longitudinal seam. Stagger all joints between layers.
2. Each layer may be held in place using tape, wire, adhesive spray, or banding. The use of tape and spray adhesives is not permitted. Install metal cladding in typical fashion and seal.
3. Elbow Fittings: Provide manufacturer's single-piece elbow fittings and apply as many layers as required to meet the minimum insulation thickness requirements, or, Contractor may cut the insulation blanket in a gore pattern per the manufacturer's recommendation and apply to the elbow in layers, staggering the seams where possible. Reference manufacturer's cutting charts for proper size and pattern of cuts for pipe fittings.

END OF SECTION

SECTION 23 81 26

SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Split system air conditioning wall, ceiling-mounted units.

1.2 REFERENCES

- A. ARI 210 - Unitary Air Conditioning Equipment.
- B. ARI 240 - Air Source Unitary Heat Pump Equipment.
- C. ANSI NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- F. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. ASHRAE 52 - Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- H. ASTM B1003 - Standard Specification for Seamless Copper Tube for Linesets.
- I. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.
- J. UL - Underwriters' Laboratories.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Indicate drain, electrical, and refrigeration rough-in connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- B. Comply with manufacturer's installation instruction for rigging, unloading, and transporting units.
- C. Protect units from weather and construction traffic by storing in dry, roofed location until units are ready for immediate installation.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A for the installation of computer room air conditioning units.
- B. Conform to ASHRAE 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 WARRANTY

- A. Provide five (5) year manufacturer's warranty on all compressors.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM WALL AND CEILING-MOUNTED UNITS

A. Manufacturers:

- 1. LG
- 2. Daikin Applied
- 3. Trane/Mitsubishi

B. Manufactured Units:

- 1. Provide packaged, air-cooled, factory assembled, pre-wired and pre-piped unit consisting of cabinet, fans, filters, remote condensing unit, and controls. Wall-mounted units shall be furnished with integral wall mounting bracket and mounting hardware.
- 2. Assemble unit for wall-mounted or ceiling installation with service access required.
- 3. Performance shall be as scheduled on the drawings.
- 4. Unit shall be rated per AHRI Standards 210/240 and listed in the AHRI directory as a matched system.
- 5. Provide unit with factory-supplied cleanable air filters.
- 6. The units shall be listed by Electrical Laboratories (ETL) in accordance with UL-1995 certification and bear the ETL label.
- 7. All wiring shall be in accordance with the National Electric Code (NEC).

C. Evaporator Cabinet and Frame:

1. Cabinet:

- a. Refer to schedule on drawings for mounting type (wall-mounted).
- b. Exposed units shall have a finished appearance with concealed refrigerant piping, condensate drain piping, and wiring connections.

D. Evaporator Fans and Motors:

1. Fans:
 - a. The evaporator fan shall be direct drive with a single motor having permanently lubricated bearings.
 - b. The fan shall be statically and dynamically balanced.
 - c. The indoor fan shall have at least three speeds.
 2. Motor:
 - a. Direct driven, digitally controlled with multiple speeds. Permanently lubricated with internal overload protection.
- E. Evaporator Coils (Direct Expansion):
1. Direct expansion cooling coil of seamless copper tubes expanded into aluminum fins.
 2. Single refrigeration circuit with externally equalized expansion valve.
 3. Coils shall be pressure tested at the factory.
 4. A sloped, corrosion-resistant condensate pan with drain shall be provided under the coil.
- F. Electrical Panel:
1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code and local electrical codes.
- G. Control:
1. The unit shall have a hard-wired 7-day programmable remote controller to operate the system. Provide wall mounting bracket for controller.
 2. Remote controller shall have "automatic", "dry" (dehumidification), and "fan only" operating modes.
 3. The remote controller shall have the following features:
 - a. On/Off power switch.
 - b. Mode Selector to operate the system in auto, cool, heat, fan, or dehumidification (dry) operation.
 - c. Fan Setting to provide multiple fan speeds.
 - d. Swing Louver for adjusting supply louver discharge.
 - e. On/Off Timer for automatically switching the unit off or on.
 - f. Temperature Adjustment allows for the increase or decrease of the desired temperature.
 - g. Powerful Operation to allow quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time.
 4. The remote controller shall perform fault diagnostic functions that may be system related, indoor or outdoor unit related depending on the fault code.
 5. Temperature range on the remote controller shall be 64°F to 90°F in cooling mode and 50°F to 86°F in heating mode.
 6. The indoor unit microprocessor shall have the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote controller.
 7. Integration: Manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135. This may be accomplished through a system integration panel or "gateway". Integration panels shall be provided as part of the split system.

H. Outdoor Unit:

1. General:

- a. The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be completely factory assembled and pre-wired with all necessary electronic and refrigerant controls.

2. Cabinet:

- a. The outdoor unit shall be fabricated of galvanized steel, bonderized and coated with a baked enamel finish for corrosion protection.

3. Fan:

- a. The fan shall be direct drive, propeller type fan with fan guard.
- b. Fan blades shall be statically and dynamically balanced.
- c. The fan shall have permanently lubricated type bearings.
- d. Motor shall be protected by internal thermal overload protection.
- e. Airflow shall be horizontal discharge.

4. Coil:

- a. The outdoor coil shall be nonferrous construction with corrugated fin tube.
- b. The coil shall be protected with an internal guard.
- c. Refrigerant flow from the condenser shall be controlled via a metering device.

5. Compressor:

- a. Hermetic or scroll refrigerant compressors with resilient suspension system, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.
- b. The outdoor unit shall have an accumulator and four-way reversing valve.

6. Refrigerant:

- a. Unit shall use R-410a.
- b. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

I. Integral Condensate Pump:

- 1. Packaged unit matched to evaporator unit including float switch, pump, motor assembly, check valve, and reservoir.
- 2. Provide alarm to indicate high level reservoir.
- 3. Unit shall be powered from evaporator unit with appropriate field connections available.

J. Condensate Pump:

2.2 PIPING

A. Design Pressure: 450 psig; Maximum Design Temperature: 250°F.

B. Type ACR Seamless Copper Tube Linesets; Brazed Joints:

1. 3/4" and under.
2. Tubing: Type ACR seamless copper tube linesets, ASTM B1003. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged, and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.
6. Limitations:
 - a. Only between refrigerant splitter box and indoor terminal unit.
 - b. For use above ceiling only. Do not use in exposed areas.

C. Type ACR Hard Drawn Seamless Copper Tube; Brazed Joint:

1. 4" and under.
2. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
3. Joints: Brazed with silver solder.
4. Fittings: Wrought copper solder joint, ANSI B16.22.
5. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

D. Piping - 1-3/8" and Under; Dual Concentric Crimp Mechanical Press Connection (Contractor's Option):

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
2. Joints: Dual concentric crimp band mechanical press connection.
3. Fittings: Refrigerant grade copper in accordance with ASTM B75 or ASTM B743 with embedded HNBR O-ring.
4. Manufacturers:
 - a. Rapid Locking System (RLS)
 - b. Conex Banninger
 - c. Parker Hannifin
 - d. MaxiPro ACR
 - e. Nibco ACR Press

E. Refrigerant linesets are permitted.

1. Provide manufacturer-packaged refrigerant linesets and accessories of sizes needed for installation. Verify lengths of piping required for installation.

2.3 INSULATION

- A. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Minimum 1/2" thick for pipe sizes less than 1-1/4" and 3/4" thick for pipe sizes 1-1/4" and above.

2.4 ROOM REFRIGERANT DETECTOR

- A. Occupied space wall-mounted refrigerant detector. Suitable to sense refrigerant types as specified with split system.
- B. White plastic finished enclosure, approximate dimensions of 4.5" x 4.5" x 1.75" deep.
- C. Power Supply: 24VAC, 24A or 120V AC, 4W.
- D. Outputs: 0-10VDC.
- E. Alarm: 80dB @ 12".
- F. Operating Environment: 32F-122F; 0-90%RH non-condensing.
- G. Sensing Parameters: Range: 0-1000ppm; minimum detection 25ppm; minimum alarm 50ppm; Repeatability +/-10ppm @ 50ppm; linearity +/-20% of reading between 50-100ppm.
- H. Manufacturers:
 - 1. Bacharach MVR (120VAC)
 - 2. SensAC (120V)
 - 3. SENVA (24V)

2.5 ROOF MOUNTING CURB

- A. Curb height as shown on drawings., minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.

2.6 EXPANSION COMPENSATION

- A. Assembly consisting of two flexible connectors, two copper flexible connectors, two 90° elbows, and a 180° return pipe. Unit shall be in the form of a pipe loop.
- B. Connectors shall have corrugated copper hose bodies with copper braided casings.
- C. Connectors shall be rated for 150 psi working pressure at 70°F.
- D. Sizes 2" and smaller shall have copper sweat ends.
- E. Connectors shall be suitable for 1/2" permanent misalignment.
- F. Manufacturer:
 - 1. Metraflex Type MLS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that proper power supply is available.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
2. Install units in accordance with manufacturer's instructions. Install all units level and plumb. Indoor units shall be installed using manufacturer's standard mounting hardware securely fastened to building structure.
3. Refer to Section 23 05 29 for roof support rails for outdoor unit.
4. Coordinate the exact mounting location of all indoor and outdoor units with architectural and electrical work. Coordinate installation of ceiling-mounted units with ceiling grid layout. Provide additional ceiling grid reinforcement or modification as required and coordinate the work with the GC. Locate the indoor unit where it is readily accessible for maintenance and filter changes. Where outdoor units are located on the roof, locate at least 10' from the roof edge.
5. Verify locations of wall-mounted remote controllers with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Height above finished floor shall not exceed 48".
6. Maintain minimum clearances to all equipment. Maintain manufacturer's minimum maintenance, and airflow clearances, and maintain minimum spaces about electrical equipment, whichever is greater.
 - a. 120V: 36" deep x 30" wide or the width of the panel whichever is wider.
 - b. 208V: 42" deep x 30" wide or the width of the panel whichever is wider.
 - c. 480V: 42" deep x 30" wide or the width of the panel whichever is wider.

B. Condensate Removal:

1. Install condensate piping with trap and route from drain pan to nearest drain. Discharge to nearest code-approved receptor or to a properly vented indirect waste fitting. Flush all piping before making final connections to units.

C. Comb all coils to repair bent fins.

D. Install new filters in the unit at Substantial Completion.

E. A factory-authorized service agent shall assist in commissioning the unit and inspecting the installation prior to startup. Submit startup report with O&M manuals.

3.3 REFRIGERANT PIPING

- A. Install refrigerant piping from the indoor unit(s) to the condensing unit. Refrigerant pipe sizes, lengths, specialties and configurations shall be as recommended by the manufacturer. Evacuate refrigerant piping and fully charge system with refrigerant per manufacturer's requirements.
- B. Provide weather-tight insulated roof curb to accommodate refrigerant piping and conduit roof penetrations.
- C. Insulate all refrigerant piping. Both liquid and suction lines shall be insulated between the indoor and outdoor units.
- D. Joining of Piping:

1. Brazed Joints:
 - a. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.
 - b. Flux shall conform to ANSI/AWS A5.31.
 - c. Remove composition discs and all seals during brazing if not suitable for a minimum of 840°F or greater than the melting temperature of the brazing filler metal, whichever is greater.

2. Mechanical Press Connection:
 - a. Copper press fitting shall be made in accordance with the manufacturer's installation instructions.
 - b. Examination: Upon delivery to the jobsite, examine copper tubing and fittings for debris, defects, incise marks (manufacturer's engraving on tube), holes, or cracks.
 - c. Fully insert tubing into the fitting and mark tubing.
 - d. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.
 - e. Joint shall be pressed with a tool approved by the manufacturer.
 - f. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

E. Insulation:

1. Insulate all refrigerant pipes between the heat pump and indoor units with Type B flexible elastomeric foam insulation (refer to Specification Section 23 07 19). This includes the liquid pipe, the suction pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant components in the piping between the indoor and heat pump units shall also be insulated. The insulation shall have a continuous vapor barrier and shall pass through hangers and supports unbroken. All exterior insulated piping shall be provided with aluminum jacketing and pipe labeling to denote refrigerant suction and liquid lines. Seal all aluminum jacketing for weatherproofing. Over size hangers and supports to allow the insulation to pass through unbroken. Following are the minimum insulation thicknesses unless noted otherwise in the manufacturer's literature or required by local AHJ:
 - a. Code/Year: IECC 2018. Provide 1" insulation on all refrigerant piping.

END OF SECTION

SECTION 23 82 00

TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric Baseboard Heaters.

1.2 QUALITY ASSURANCE

- A. All filters shall be UL listed Class 1 or Class 2.
- B. All electrical equipment shall have a UL label.
- C. All gas fired units shall be AGA approved or UL listed.
- D. All gas trains shall comply with utility company and code requirements.
- E. All louvers and dampers shall have AMCA certified ratings.
- F. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 REFERENCES

- A. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. ASHRAE 200 - Methods of Testing Chilled Beams

1.4 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00.
- B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.
- C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.
- D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.
- E. Submit manufacturers' installation instructions.

- F. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- G. Submit certification that terminal heat transfer units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.6 REGULATORY REQUIREMENTS

- A. Conform to ASHRAE 90.1.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 ELECTRIC BASEBOARD HEATERS

- A. Assembly: UL listed and labeled with built-in controls and terminal box with cover.
- B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material. Linear overheat protection.
- C. Enclosure: 22 gauge steel with 7" high back and top of one piece. Front panel, end panel, end caps, corners, and joiner pieces snap together. Front panel easily removable.
- D. Element Hangers: Quiet operating, ball bearing cradle type with unrestricted longitudinal movement on enclosure brackets.
- E. Thermostat: Built-in factory wired bi-metal line voltage.
- F. Manufacturer:
 - 1. Chromalox.
 - 2. Berko.
 - 3. Reznor.

4. Design-Architectural-Heating.
5. Redd-i.

2.2 ARCHITECTURAL ELECTRIC WALL HEATERS

- A. Assembly: UL listed and labeled with terminal box and cover, fan guard, and built-in controls. Draw-through design. Provide with baked enamel finished steel back box suitable for wall mounting.
- B. Heating Elements: Nickel-chromium resistance wire enclosed in a steel sheath with copper brazed plate fins.
- C. Cabinet: Minimum 20 gauge steel with baked enamel finish. Provide surface mount, semi-recessed or fully recessed cabinet as called for on drawings.
- D. Front Panel: Bar grille constructed of minimum 16 gauge cold-rolled steel, welded into a uniform grille and finished in baked enamel. Front grille shall have a satin finished aluminum frame around the periphery.
- E. Fan: Direct drive propeller type, statically and dynamically balanced.
- F. Motor: Permanently lubricated sleeve bearings, totally enclosed, automatic reset thermal overload protection.
- G. Control: Unit-mounted tamper-proof thermostat, thermal cutout, double-pole single throw unit mounted disconnect covered by protective front panel.
- H. Manufacturer:
 1. Qmark Model AWH.
 2. Markel Series 3400.
 3. Berko Series FRC.
 4. Redd-i.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 1. Install all products per manufacturers' instructions.
 2. Coordinate recess sizes for recessed equipment.
 3. Protect units with protective covers during construction.
 4. Comb all coils to repair bent fins.

3.2 CLEANING

- A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.

C. Install new filters.

END OF SECTION

SECTION 26 05 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)

1.3 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. Reference Drawings: The work of this section is shown in the following Contract Drawings:
E000, E100, E101, E200, E201, E210, E211, E212, E220, E221, E600, E601, E602, E603, E800, E801.
Refer to Architectural drawings for coordination of electrical system geometry.
- D. Reference Specifications:
 - 1. 26 05 00 – BASIC ELECTRICAL REQUIREMENTS
 - 2. 26 05 03 – THROUGH PENETRATION FIRESTOPPING
 - 3. 26 05 13 – WIRE AND CABLE
 - 4. 26 05 17 – ELECTRIC HEAT TRACE AND SNOW MELT
 - 5. 26 05 26 – GROUNDING AND BONDING
 - 6. 26 05 27 – SUPPORTING DEVICES
 - 7. 26 05 33 – CONDUIT AND BOXES
 - 8. 26 05 35 – SURFACE RACEWAYS
 - 9. 26 05 53 – ELECTRICAL IDENTIFICATION
 - 10. 26 05 73 – POWER SYSTEM STUDY
 - 11. 26 09 33 – LIGHTNING CONTROL SYSTEMS
 - 12. 26 22 00 – DRY TYPE TRANSFORMERS
 - 13. 26 24 16 – PANELBOARDS
 - 14. 26 28 16 – DISCONNECT SWITCHES
 - 15. 26 51 19 – LED LIGHTING
 - 16. 26 52 15 – EMERGENCY LIGHTING INVERTER
 - 17. 27 05 28 – INTERIOR COMMUNICATION PATHWAYS

18. 27 05 43 – EXTERIOR COMMUNICATION PATHWAYS
19. 28 05 00 – BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS
20. 28 26 05 – RESCUE ASSISTANCE COMMUNICATION
21. 28 31 00 – FIRE ALARM DETECTION SYSTEMS

E. Description of Systems shall be as follows:

1. Electrical power distribution system including branch panelboards.
2. Conduit.
3. Wire and cable.
4. Outlets and devices.
5. Lighting fixtures.
6. Lighting control system.
7. Emergency battery drivers.
8. Remote battery systems.
9. Electrical provisions for mechanical and plumbing equipment.
10. Structured horizontal cabling system for voice and data.
11. Electrical power service system upgrades from the Utility Company to and including service entrance equipment, distribution and metering.
12. Grounding system.
13. Addressable fire alarm system.
14. Nameplates and tags.
15. CCTV system.
16. Mineral insulated heated cable for heated slab and controls.
17. Heat trace cable and controls.
18. Rescue assistance communication system.
19. Removal work and/or relocation and reuse of existing systems and equipment.
20. Technology Systems as described in Division 27/28 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.
21. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

F. Work Not Included:

1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.4 OWNER FURNISHED PRODUCTS

- A. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- B. This Contractor shall make all electrical system connections shown on the drawings or required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.
- B. Itemize all work and list associated hours and pay scale for each item.

1.6 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
 - 1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
 - 2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
 - 3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
 - 4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
 - 5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
 - 6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
 - 7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
 - 8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
 - 9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.
 - 10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Luminaires.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical bus duct.
 - d. Sheet metal.
 - e. Cable trays, including access space.
 - f. Other piping.
 - g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".
2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.
3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.
4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the telecommunications ground bar.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.7 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the [Mechanical Contractor].

- a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.8 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
 1. Submittals list:

| Referenced Specification Section | Submittal Item | Coordination Drawing |
|----------------------------------|-----------------------------------|----------------------|
| 26 05 03 | Through Penetration Firestopping | |
| 26 05 13 | Wire and Cable | |
| 26 05 17 | Electric Heat Trace and Snow Melt | Yes |
| 26 05 23 | Manufactured Wiring Assemblies | |
| 26 05 26 | Grounding and Bonding | |
| 26 05 27 | Support Devices | |
| 26 05 33 | Conduit and Boxes | Yes |
| 26 05 35 | Surface Raceways | |
| 26 05 53 | Electrical Identification | |
| 26 05 73 | Power System Study | Yes |
| 26 09 33 | Lighting Control System | |
| 26 22 00 | Dry Type Transformers | Yes |
| 26 24 16 | Panelboards | Yes |
| 26 28 16 | Disconnect Switches | |
| 26 51 19 | LED Lighting | Yes |
| 26 52 15 | Emergency Lighting Inverter | Yes |
| 28 26 05 | Rescue Assistance Communication | |
| 28 31 00 | Fire Alarm and Detection Systems | Yes |
| Drawings | Photocells, Timeclocks, Relays | |

1.9 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
 3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
 - a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.
 - b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
 - c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
 - d. Fire alarm broken down into material and labor for the following:
 - 1) Engineering
 - 2) Controllers, devices, sensors, etc.
 - 3) Conduit
 - 4) Wiring
 - 5) Programming
 - 6) Commissioning
 - e. Site utilities (5' beyond building)
 - f. Seismic design

- g. Testing
- h. Commissioning
- i. Record drawings
- j. Punchlist and closeout

- D. Update Schedule of Values when:
- 1. Indicated by Architect/Engineer.
 - 2. Change of subcontractor or supplier occurs.
 - 3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.11 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- B. The following network connected equipment shall be equipped with restricted access protocols:
 - 1. Adjustable trip overcurrent protection devices
 - 2. Power monitoring and control
 - 3. Electrical controls
 - 4. Lighting control system
 - 5. Variable frequency drives

6. Package engine generator and remote annunciator
7. Transfer switch and remote annunciator
8. Static uninterruptible power supply (UPS)
9. Fire alarm and automatic detection

1.13 WARRANTY

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.14 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.

- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
 - 2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with the work.
- B. Excavation:
 - 1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
 - 2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
 - 3. Trim bottom and sides of excavations to grades required for foundations.
 - 4. Protect excavations against frost and freezing.
 - 5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
 - 6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.
9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.
10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand and/or CA6 for backfilling.
3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.
4. Dispose of the excess excavated earth as directed.
5. Backfill materials (native soil material, sand, and/or CA6) shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.
9. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.

10. Backfill with native soil material (if approved) or sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.
11. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.
12. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
13. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.
 - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
 - c. Luminaire whips are supported above the ceiling.
 - d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.
 - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
 - f. All wall penetrations have been sealed.

2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. The instructions shall include:
 1. Maintenance of equipment.
 2. Start-up procedures for all major equipment.
 3. Description of emergency system operation.
- F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- G. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- H. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.5 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

3.6 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.
- G. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.
- H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.
 - a. Color of paint shall be as follows:<Insert>.

3.7 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.8 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.
- D. Raceway and Cable Routing Restrictions: Raceways and cable are restricted from being routed in the following locations, unless serving the space or permitted by the authority having jurisdiction.
 1. Elevator machine rooms and hoistways.
 2. Exit enclosures.
 3. Other areas restricted by code.
 4. Technology, data, server rooms.
 5. Fire pump and sprinkler rooms.
 6. Normal power in emergency power equipment rooms: Limited to feeders and branch circuits serving the emergency power equipment located in the room.
 7. Emergency power in normal power equipment rooms: Limited to feeders and branch circuits serving the normal power equipment located in the room.

3.9 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Within the Limits of Construction:
 1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
 2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.
- B. Outside the Limits of Construction:
 1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.

2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.
- C. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
1. [General Contractor]<Insert> shall erect and maintain dust barriers throughout the construction work. These barriers shall be reasonably airtight and shall prevent entry into the construction zone by unauthorized persons. Reasonably airtight means construction equivalent to full-height temporary or permanent walls with joints taped or sealed, and shafts and other penetrations sealed as well as possible. Fire resistant polyethylene is acceptable; if flame spread/smoke developed ratings are demonstrated to conform to the applicable building codes and licensing acts.
 2. The Contractor shall continuously maintain the construction zone under a negative pressure of at least 0.01" w.g. minimum relative to all adjacent areas of the building.
 - a. Exhaust fans used for this purpose shall filter air and discharge it outdoors or to the least populated area adjacent to the construction work using negative air machines designed specifically for this purpose. All filtration for air recirculated back into the building shall be HEPA (99.97% DOP efficiency) for work adjacent to healthcare or elderly facilities. If no work is adjacent to these areas, [95%]<Insert> filtration is acceptable. Filtering air discharged to outdoors shall be accomplished with [30%]<Insert> filters.
 - b. If air is discharged outdoors, maintain all required distances to doors, windows, air intakes, etc.
 - c. If high levels of Volatile Organic Compounds (VOC's) or odors are released, activated carbon or equivalent filtration shall also be employed. Exhaust shall not discharge near doors, air intakes, pedestrians, gathering areas, or operable windows.
 - d. Adjusting existing air handling equipment to assist in pressure control is acceptable, if approved by the Owner and the authority having jurisdiction.
 - e. Seal return, exhaust, and supply air openings in or near the construction zone that serve existing air handling systems, and rebalance the systems for proper operation. If this is impractical, add filters at the intakes of sufficient cross sectional area to minimize the pressure drop and avoid the need for rebalancing.
 - f. Maintain pressure control one hour before and after all construction periods, and 24 hours per day in healthcare or elderly facilities.
 3. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 4. Request that the Owner designate an IAQ representative.
 5. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
 6. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.

7. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
8. Request copies of and follow all Owner's IAQ and infection control policies.
9. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
10. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
11. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings under Construction".

3.10 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.11 FIELD QUALITY CONTROL

- A. General:
 1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
 3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
 4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
 5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
 6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)
2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain. [Ground resistance values shall be verified by the Architect/Engineer at the time the readings are taken.]
3. If the ground resistance value obtained is more than the value set forth in Section 26 05 26, the following shall be done to obtain the value given:
 - a. Verify that all connections in the service ground system are secure.
 - b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.
 - c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.
 - d. Review results with the Architect/Engineer.
4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:
 - a. Date of test.
 - b. Number of hours since the last rain.
 - c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.
 - d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.
 - e. Make, model, and calibration date of test equipment.
 - f. Tabulation of measurements taken and calculations made.

C. Ground-Fault Equipment Performance Testing:

1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:
 - a. Service disconnects
 - b. Solid state molded case circuit breakers and solid-state insulated case circuit breakers equipped with ground fault protection.
 - c. Fusible switches with ground fault relay protection.
 - d. Outside branch circuits and feeders.
 - e. Code required.
2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.

D. Arc Energy Reduction Equipment Performance Testing:

1. Test: Perform arc energy protection performance testing when system is installed. The test process shall use primary current injection or approved method per manufacturer instructions and procedures. Perform test for the following:
 - a. All arc energy reduction systems installed.
2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.

E. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

F. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

G. Contractor shall thermographic study all electrical gear, switchboard, panelboards, etc. at the end of construction to identify any unusual conditions/heating within the equipment. Coordinate with Owner/Architect/Engineer to have an Owner/Architect/Engineer representative present during testing.

H. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.

I. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for "benchmark" amperages.

3.12 UTILITY REBATE

- A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.
- B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, medium voltage testing report has been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 26 05 03

THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 REFERENCES

- A. UL 263 - Fire Tests of Building Construction and Materials.
- B. UL 723 - Surface Burning Characteristics of Building Materials.
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops.
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
- H. International Building Code.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

1.3 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- C. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- D. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.4 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Project Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.5 WARRANTY

- A. Provide one year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

| <u>Penetrating Item</u> | <u>UL System No.</u> |
|---|----------------------|
| No Penetrating Item | FC 0000-0999* |
| Metallic Pipe or Conduit | FC 1000-1999 |
| Non-Metallic Pipe or Conduit | FC 2000-2999 |
| Electrical Cables | FC 3000-3999 |
| Cable Trays | FC 4000-4999 |
| Insulated Pipes | FC 5000-5999 |
| Bus Duct and Misc. Electrical | FC 6000-6999 |
| Duct without Damper and Misc. Mechanical | FC 7000-7999 |
| Multiple Penetrations | FC 8000-8999 |
| *Alternate method of firestopping is patching opening to match original rated construction. | |

| <u>Penetrating Item</u> | <u>UL System No.</u> |
|---|----------------------|
| No Penetrating Item | WL 0000-0999* |
| Metallic Pipe or Conduit | WL 1000-1999 |
| Non-Metallic Pipe or Conduit | WL 2000-2999 |
| Electrical Cables | WL 3000-3999 |
| Cable Trays | WL 4000-4999 |
| Insulated Pipes | WL 5000-5999 |
| Bus Duct and Misc. Electrical | WL 6000-6999 |
| Duct without Damper and Misc. Mechanical | WL 7000-7999 |
| Multiple Penetrations | WL 8000-8999 |
| *Alternate method of firestopping is patching opening to match original rated construction. | |

| Penetrating Item | UL System No. |
|--|----------------|
| No Penetrating Item | CAJ 0000-0999* |
| Metallic Pipe or Conduit | CAJ 1000-1999 |
| Non-Metallic Pipe or Conduit | CAJ 2000-2999 |
| Electrical Cables | CAJ 3000-3999 |
| Cable Trays | CAJ 4000-4999 |
| Insulated Pipes | CAJ 5000-5999 |
| Bus Duct and Misc. Electrical | CAJ 6000-6999 |
| Duct without Damper and Misc. Mechanical | CAJ 7000-7999 |
| Multiple Penetrations | CAJ 8000-8999 |

*Alternate method of firestopping is patching opening to match original rated construction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 CLEANING AND PROTECTING

- A. Clean 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 cause damage.
- 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, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.3 IDENTIFICATION

- A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
 - 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 26 05 13

WIRE AND CABLE

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.2 REFERENCES

- A. ASTM B800-05 - Standard Specification for 8000 Series Aluminum Alloy Wire Electrical Purposes- Annealed and Intermediate Tempered.
- B. ASTM B801-07 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation.
- C. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy.
- D. NFPA 70 - National Electrical Code (NEC).
- E. UL 44 - Thermoset-Insulated Wires and Cables.
- F. UL 83 - Thermoplastic-Insulated Wires and Cables.
- G. UL 854 - Service-Entrance Cables.
- H. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords.
- I. UL 2196 - Fire Resistive, Fire Resistant and Circuit Integrity Cables.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and Branch Circuits: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.
- B. The minimum size for branch circuit wiring shall be #12AWG.

2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
 - 1. Fire alarm
 - 2. Low voltage switching and lighting control

3. Other specialized cabling, signal, and power limited cabling. Refer to the appropriate Division 23, 27, or 28 requirements; including, but not limited, to the following:
 - a. [Electronic Access Control, Intrusion Detection Systems, Video Surveillance, Division 28.]
 - b. [Rescue Assistance Communication System, Division 28.]

PART 3 - EXECUTION

3.1 CONTRACTOR CHANGES

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C,. Service entrance[and fire pump feeder] conductors are based on copper conductor installed in underground electrical ducts.
- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
- C. Underground electrical duct ampacity rating shall be in accordance with NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)) or calculated in accordance with Annex B Application Information for Ampacity Calculation, NEC Table B.2(7) (2011 - 2017 edition Table B310.15(B)(2)(7); 2008 or later edition B.301.7) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.
- D. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.
- E. Record drawing shall include the calculations and sketches.

3.2 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.
- D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
- E. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
- F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

- G. Splice only in junction or outlet boxes.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Make conductor lengths for parallel circuits equal.
- J. All conductors shall be continuous in conduit from last outlet to their termination.
- K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
- L. Cables or wires shall not be laid out on the ground before pulling.
- M. Cables or wires shall not be dragged over earth or paving.
- N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.3 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Do not use wire pulling lubricant for isolated (ungrounded) power system wiring.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.
- H. Conductor Supports in Vertical Raceways:
 - 1. Support conductors in vertical raceways in accordance with the Electrical Code Spacing of Conductors Supports.

2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

3.4 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Use suitable cable fittings and connectors.
- C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.
- D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.
- E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.
- F. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.
- G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.5 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor. Cold shrink connector insulator with 1kV rating shall be used in damp and wet locations.

- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
- I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. Top to Bottom - A-B-C
- J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.
- K. Use antioxidant joint compound on all aluminum conductor terminations. Apply antioxidant joint compound per manufacturer's recommendations.

END OF SECTION

SECTION 26 05 17

ELECTRIC HEAT TRACE AND SNOW MELT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Heat tracing cables.
- B. Snow and ice melting cables.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC).
- B. ASTM 2633 - Standard Test Method for Thermoplastic Insulations.
- C. ASTM B193 - Standard Test Method for Resistivity of Electrical Conductor Materials.
- D. UL 746B - Polymeric Materials - Long Term Property Evaluations.
- E. NFPA 13 - Standard for Installation of Sprinkler Systems.

1.3 COORDINATION

- A. Coordinate layout and installation of electrical heating cables and system components with General Contractor.
- B. Coordinate installation of snow-melting cable with installation of concrete framework and concrete placement.

PART 2 - PRODUCTS

2.1 HEAT-TRACING CABLE

- A. Self-Regulating Heating Cable:
 - 1. Cable shall be capable of crossing over itself without overheating.
 - 2. Provide power end seals and splices as required.
 - a. Each circuit shall be protected by a 30-mA ground-fault protection device. Provide number of breakers based on manufacturer's maximum length for startup at 0°F. Identify breaker in panel directory as "HEAT TAPE".
 - 3. Heat tape shall be meggered prior to insulating piping.

4. HT-3; Suitable for freeze protection of above grade insulated metal or plastic piping, valves, and equipment to maintain fluid temperature above 40°F.[5][8] watts per foot @ 50°F, 120 V.
 - a. Manufacturers:
 - 1) Ray-Chem XL1
 - 2) Chromalox SRL
 - 3) Thermon BSX
 - 4) Delta-Therm IN

5. HT-2: Suitable for freeze protection of underground insulated metal or plastic piping to maintain fluid temperature above 40°F.[5][8] watts per foot, 120 V.
 - a. Manufacturers:
 - 1) Ray-Chem XL
 - 2) Chromalox SRL
 - 3) Thermon BSX
 - 4) Delta-Therm IN

2.2 SNOW AND ICE MELTING CABLES

A. Self-Regulating Cable:

1. Heat tape shall be meggered prior to paving installation.
2. Provide power connection, end seal, splices and expansion joint kits as required.
3. Each circuit shall be protected by a 30-mA ground-fault protection device. Provide number of breakers based on manufacturer's maximum length for startup at 0°F. Identify breaker in panel directory as "SNOW MELT".
4. HT-1; Suitable for installation in concrete pavement to melt snow and ice. 45 watts per square foot, 277 V. Cables must be secured to reinforcing steel or mesh. Cable spacing shall not exceed 12". Cables must be installed 1-1/2" to 2" below finished surface.
 - a. Manufacturers:
 - 1) Ray-Chem EM2-XR
 - 2) Chromalox
 - 3) Thermon
 - 4) Delta-Therm

2.3 CONTROLS

A. SMP-1; Snow Melt Distribution and Control Panel with Remote Snow Sensors:

1. Branch circuit and control panel with ground fault protection branch breakers. Snow melt control panel with adjustable hold-on timer, automatic/off/manual switch. Provide with remote Class II aerial solid state precipitation and temperature sensor and a pavement-mounted snow sensor. Two (10mA) override inputs and four (10mA) contacts to support remote monitoring and control.
2. Manufacturers:
 - a. Pentair SMPG1

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surface and substrates to receive heating cables for compliance with requirements for installation, tolerances, and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electrical heating cables are free of burrs and sharp protrusions.
 - 2. Ensure pipe testing is complete.
 - 3. Ensure surfaces and substrates are level and plumb.
- B. Test cables for electrical continuity before installing.
- C. Test cables for insulation resistance before installing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Verify field measurements are as shown on the Drawings.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. The heating cable shall be protected from where it leaves the pavement to the junction box by installing the cable in rigid metal conduit. Use one conduit for each heating cable.
- C. Avoid crossing expansion, construction, or control joints with heating cables. Provide sufficient slack conductor in expansion loop.
- D. Do not energize cables embedded in concrete, asphalt, or plaster until those assemblies are cured, except for brief testing.
- E. Install cables after applying bituminous binder course to lower base. Ensure that second labeling bituminous binder is applied to cables before pouring finish topping.
- F. Provide labeling in paving where snow melt cables are present. A metal plate or stamp used prior to concrete setting must contain the name of the snow melt company, the word "CAUTION", the phrase "EMBEDDED SNOW MELTING SYSTEM", and the date the system was installed. The labeling of the system must be able to handle the outdoor environment without degrading.
- G. Provide labeling to outside of the pipe thermal insulation weather barrier to indicate the presence of electric heating tracing. Labeling should contain the name of the heat trace company, the word "CAUTION" and the phrase "ELECTRIC HEAT TRACE". Labels should be placed every ten feet of pipe alternating on either side of the pipe.

3.3 CONNECTIONS

- A. Cable splices and repairs shall be made using a splice kit provided by the manufacturer and specifically designed for that purpose.

- B. Power connection and end seal junction box shall be mounted above grade. The junction box shall be installed in such a way so that water cannot enter it.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding system.
- B. Bonding system.
- C. Grounding electrode system.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC).
- B. NFPA 99 - Standard for Healthcare Facilities.

1.3 SUMMARY

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- D. Isolated Ground Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

H. GB; Grounding Bar:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of technology or applicable room.

I. IBT; Intersystem Bonding Termination:

1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.

2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING ELECTRODES

- A. Ground Rods Copper-clad steel.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- C. Underground Connections: Use for underground connections, except those at test wells.
- D. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity.[The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.]

- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A[and UL 486B].
- F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

- A. In raceways, use insulated equipment grounding conductors.

3.3 EQUIPOTENTIAL (MULTI-POINT) GROUNDING SYSTEM

- A. Provide an equipotential grounding system in the following locations:
 - 1. Class I Div 1 and Div 2 locations as required in Electrical Code.
 - 2. Swimming pool, fountains, and similar locations as required in Electrical Code.
 - 3. Critical patient care and special care areas as indicated on drawings.
- B. The non-current-carrying metal parts of equipment, raceways and other enclosures shall be bonded to the grounding system.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

- A. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

3.5 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION

SECTION 26 05 27

SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and Equipment Supports.
- B. Foundation and Underground Sleeves and Seals.

1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 COORDINATION

- A. Coordinate size, shape and location of concrete pads with section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allied Support Systems.
- B. Cooper B-Line.
- C. Erico, Inc.
- D. Hilti.
- E. Power Fasteners.
- F. Orbit Industries.

2.2 MATERIAL

- A. Support Channel: Hot-dip galvanized for wet/damp locations; painted steel [for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting].
- B. Hardware: Corrosion resistant.

C. Anchorage and Structural Attachment Components:

1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.
 - a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
3. Welding Lugs: Comply with MSS-SP-69, Type 57.
4. Beam clamps for Steel Beams and Joists: Double sided or concentric open web joist hangars. Single-sided type is not acceptable.
5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.
7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of [ACI 318-05]. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

D. Conduit Sleeves and Lintels:

1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.
2. Refer to Structural plans and specifications for lintel requirements and sizes.

| Model | Service | Element Material | Temperature Range |
|-------|---------------------------|---------------------|-------------------|
| S | Standard (Stainless) | EPDM | -40°F to 250°F |
| T | Fire Seals (1 hour) | Silicone | -67°F to 400°F |
| FS | Fire Seals (3 hours) | Silicone | -67°F to 400°F |
| OS | Oil Resistant / Stainless | Nitrile | -40°F to 210°F |

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Trapeze support installation: Cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- E. Do not use powder-actuated anchors without specific permission.
- F. Do not drill structural steel members.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.
- I. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting. Provide steel channel supports to stand surface-mounted panelboard or cabinet one inch off wall.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- L. Refer to Section 26 05 33 for special conduit supporting requirements.

3.2 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
- B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION

SECTION 26 05 33

CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metallic conduit and fittings (RMC).
- B. Intermediate metallic conduit and fittings (IMC).
- C. Electrical metallic tubing and fittings (EMT).
- D. Liquidtight flexible metallic conduit and fittings (LFMC).
- E. Electrical connection.
- F. Pull and junction boxes.
- G. Rough-ins.
- H. Handholes.

1.2 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
 - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated
 - 5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
 - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
 - 2. A-A-55810 - Specification for Flexible Metal Conduit
- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
 - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable

2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Underwriters Laboratories (UL): Applicable Listings
1. UL 1 - Flexible Metal Conduit
 2. UL 6 - Rigid Metal Conduit
 3. UL 360 - Liquid Tight Flexible Steel Conduit
 4. UL514-B - Conduit Tubing and Cable Fittings
 5. UL651-A - Type EB and a PVC Conduit and HDPE Conduit
 6. UL651-B - Continuous Length HDPE Conduit
 7. UL746A - Standard for Polymeric Materials - Short Term Property Evaluations
 8. UL797 - Electrical Metal Tubing
 9. UL1242 - Intermediate Metal Conduit
- G. Definitions:
1. Fittings: Conduit connection or coupling.
 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
 3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
 4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
 5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
 6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
 7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

- A. Manufacturers:
1. Allied
 2. LTV
 3. Steelduct
 4. Calbond Calpipe
 5. Wheatland Tube Co
 6. O-Z Gedney
 7. or approved equal.
- B. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

D. PVC Externally Coated Conduit: Compliant with [UL 6, ANSI C80.1 and]NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating.[Threads shall be hot galvanized and coated with a clear coat of urethane.] The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system.

1. Acceptable Manufacturers:
 - a. Calbond Calpipe
 - b. Robroy
 - c. T&B Ocal
 - d. or approved equal.

2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS

A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

B. Manufacturers:

1. Allied
2. LTV
3. Steelduct
4. Wheatland Tube Co
5. O-Z Gedney
6. or approved equal.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Manufacturers of EMT Conduit:
 1. Allied
 2. Calbond Calpipe
 3. LTV
 4. Steelduct
 5. Wheatland Tube Co
 6. or approved equal.
- C. Fittings and Conduit Bodies:
 1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.
 2. Larger than 2": Compression type of steel designed for their specific application.
 3. Manufacturers of EMT Conduit Fittings:
 - a. Appleton Electric
 - b. O-Z/Gedney Co.
 - c. Electroline
 - d. Raco
 - e. Bridgeport
 - f. Midwest
 - g. Regal
 - h. Thomas & Betts
 - i. Orbit Industries
 - j. or approved equal.

2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

- A. Manufacturers:
 1. Anaconda Type UA
 2. Electri-Flex Type LA
 3. Alflex
 4. Carlon (Lamson & Sessions)
 5. or approved equal.
- B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
3. Manufacturers:
 - a. Appleton Electric
 - b. O-Z/Gedney Co.
 - c. Electroline
 - d. Bridgeport
 - e. Thomas & Betts
 - f. Midwest
 - g. Regal
 - h. Carlon (Lamson & Sessions)
 - i. Orbit Industries
 - j. or approved equal.

2.5 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers:
 1. Carlon (Lamson & Sessions) Type 40
 2. Cantex, J.M. Mfg.
 3. or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

| ASTM Test | Description | Values HDPE |
|-----------|---|---------------------------------|
| D-1505 | Density g/CM ³ | less than 0.941 |
| D-1238 | Melt Index, g/10 min Condition E | greater than 0.55 grams/10 min. |
| D-638 | Tensile Strength at yield (psi) | 3000 min. |
| D-1693 | Environmental Stress Crack Resistance Condition B, F 20 | 96 hrs. |
| D-790 | Flexural Modulus, MPa (psi) | less than 80,000 |
| D-746 | Brittleness Temperature | -75°C Max |

2.6 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

- C. Cast Boxes: Nema FB1, Type FD, Aluminum, cast ferrous alloy, or stainless steel deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.
- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
- F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.
- G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.7 ECONN; ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.8 JB; PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

2.9 ROUGH-IN

- A. Conduits routes and rough-in of junction boxes shall be coordinated with architect and engineer. Above-ceiling spaces are limited; surface-mounted conduit routes and junction box locations shall be approved by designers prior to installation.
- B. The bridge design includes dedicated cavities for passage of conduits, refer to drawings.

- C. Conduits stubbing up to devices on ceilings and walls shall be concealed inside walls or mullions wherever possible.
- D. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate for electrical devices.

2.10 HANDHOLES

- A. Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid cover rated for 10,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve depth shown on plans. Units in landscaped areas shall be green in color. Refer to handhole detail in drawings.
 - 1. Manufacturers:
 - a. Hubbell/Quazite
 - b. Carson Industries H Series
 - c. Armorcast
 - d. Highline Products
 - e. Synertech

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.
- B. Installation Schedule: Refer to drawings.
- C. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- D. Minimum Conduit Size (Unless Noted Otherwise):
 - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
 - 2. Below Grade 5' or less from Building Foundation: 3/4 inch.
 - 3. Below Grade More than 5' from Building Foundation: 3/4 inch.
 - 4. Telecommunication Conduit: 1 inch.
 - 5. Controls Conduit: 3/4 inch.
- E. Conduit Embedded in Slabs above Grade:

1. Embedded installation NOT allowed in elevated slabs with metal composite decks nor structural pour in place slabs less than 6 inches in depth unless specifically noted or shown on drawings otherwise.
2. Maximum size 1 inch for conduits crossing each other.

F. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.

B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.

C. Conduit arrangement in elevated slabs (restricted to applications specifically noted or shown on drawings):

1. Conduit size shall not exceed one-third of the structural slab thickness. Place conduit between the top and bottom reinforcing with a minimum of 3" concrete cover.
2. Parallel conduits shall be spaced at least 8 inches apart. Exception: Within 18 inches of commonly served floor boxes, junction boxes, or similar floor devices. Arrange conduits parallel or perpendicular to building lines and walls.

D. Conduit shall not share the same cell as structural reinforcement in masonry walls.

E. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.

F. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.

G. Contractor shall cooperate with all contractors on the project. Contractor shall obtain details of other contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by Contractor. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.3 CONDUIT SUPPORT

A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.

1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.
- G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
- K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.
- L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
- M. Finish:
 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.

2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.4 CONDUIT INSTALLATION

A. Conduit Connections:

1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.
3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.

B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
2. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
3. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
 - a. A third bend is acceptable if:
 - 1) The total run is not longer than (33) feet.
 - 2) The conduit size is increased to the next trade size.
4. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
5. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
6. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
7. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.
2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.
5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. [Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal]; refer to Section 26 05 03 for through penetration firestopping requirements].
7. **CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.**
8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system, equal to O-Z/Gedney type EYD.
9. Horizontal conduit routing through slabs above grade
 - a. Conduits, if run in concrete structure, shall be in middle one-third of slab thickness, and leave at least 3" min. concrete cover. Conduits shall run parallel to each other and spaced at least 8" apart centerline to centerline. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Maximum conduit outside diameter 1".
 - b. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.
10. Do not route conduits across each other in slabs on grade.
11. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
12. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
13. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
14. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
15. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.
- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

3.6 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) OVERHEAD CONDUIT INSTALLATION

- A. Conduit shall be installed away from high temperature piping and equipment.
- B. Conduit shall be installed to prevent exposure to ultraviolet radiation.
- C. Proper allowances shall be made for expansion and/or contraction of the conduit during installation.
- D. Expansion fittings shall be installed in any 100' continuous run of conduit and at each 100' thereafter.
- E. Supports shall be made from non-corroding materials and spacing shall not be greater than the listing in the Electrical Code, but also shall not exceed the manufacturer's recommendations depending on the expected surface temperature.

3.7 UNDERGROUND CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.
- B. Conduit Bends (Lateral):
 - 1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.
 - 2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.
- C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (greater than 600V) and 18 inches for secondary conduits (less than 600V). Increase radius, as required, based on pulling tension calculation requirements.
- D. Expansion Fittings at Finished Grade: Provide underground raceways with an expansion fitting after emerging from finished grade and exterior equipment pads. Field locate the expansion fitting above and within 24 inches of finished grade. Raceways extending less than 12 inches above finished grade, transitioning to FLMC within 12 inches of finished grade, and interior concrete building slabs do not require an expansion fitting unless required by code.
- E. Conduit Placement:
1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.
 2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
 3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum $f'c = 2500$ and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
 4. Before the Contractor pulls any cables into the conduit, Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
 5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
 6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
 7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
 8. All non-metallic conduit installed underground outside of a slab shall be rigid.
- F. Horizontal Directional Drilling:
1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
 2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.
- G. Raceway Seal:
1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.
 2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with "JackMoon" or equivalent duct seal, capable of withstanding a 10-foot head of water (5 PSI).
 3. Duct Seal Alternative Option: Inflatable duct seal system. Capable of withstanding a 10-foot head of water (5 PSEI).

- a. Manufacturers:
 - 1) Raychem Rayflate Duct Sealing Systems RDSS
 - 2) Approved equal

3.8 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.
- E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.9 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 26 05 35

SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface metal raceways.

1.2 REFERENCES

- A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface.

PART 2 - PRODUCTS

2.1 SURFACE METAL RACEWAY

- A. Surface Metal Raceway: FS W-C-582; sheet metal channel with fitted cover, suitable for use as a continuous surface metal raceway.
- B. Finish: Rust inhibiting primer coat for field painting. Coordinate paint color with Architect.
- C. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- D. Boxes and Extension Rings: Designed for use with raceway systems.
- E. Coverplates shall be same material and finish as raceway.
- F. Normal power receptacles shall be same color as raceway. Coordinate color with Architect.

PART 3 - EXECUTION

3.1 INSTALLATION - ARCHITECTURAL SURFACE RACEWAY

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- C. Fastener: Use clips and straps suitable for the purpose.
- D. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.

- E. **Routing and Planning:** Coordinate routings with existing vertical/horizontal building lines and features (doorways, wall trim, at wall/ceiling interface, etc.). Match the square / parallel lines of other existing features. Do not route raceway across large open spaces of the wall unless required by the application.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhesive Markings and Field Labels.
- B. Nameplates and Signs.
- C. Product Colors.

1.2 REFERENCES

- A. NFPA 70E - National Electrical Safety Code.
- B. NFPA 70 - National Electrical Code (NEC).
- C. ANSI A13.1 - Standard for Pipe Identification.
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels.

1.3 QUALITY ASSURANCE

- A. Electrical identification products shall be suitable for the environment installed. Identification labels damaged by the environment due to ultraviolet light fading, damp or wet conditions, physical damage, corrosion, or other conditions shall be replaced with labels suitable for the environment.

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

- A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Emergency, Lighting, Power, HVAC, Communications, Control, Fire).
- B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

2.2 NAMEPLATES AND SIGNS

- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.

2.3 PRODUCT COLORS

A. Adhesive Markings and Field Labels:

1. All Labels: Black letters on white face

B. Raceways and Conduit:

1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:
 - a. Normal Power and General Distribution: Silver
 - b. Fire Alarm System: Red
 - c. Temperature Controls: Refer to mechanical cover sheet for color
 - d. Ground: Green
 - e. Low Voltage and Telephone: Purple
 - f. Clock, Sound, Security System, and Intercom: Black

C. Box Covers:

1. Box covers shall be painted to correspond with system type as follows:
 - a. Normal Power and General: Silver
 - b. Fire Alarm System: Red
 - c. Temperature Controls: Refer to mechanical cover sheet for color
 - d. Ground: Green
 - e. Clock, Sound, Security System, and Intercom: Black

D. Conductor Color Identification: Refer to Part 3 for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as [approved in submittals and as] required by code.
- B. Exposed Ceilings and Finished Spaces: The project includes exposed ceilings in finished spaces. The installation of colored raceways and labeling may not be aesthetically desirable in finished spaces. The contractor shall coordinate identification requirements in exposed ceilings of finished spaces with the A/E prior to installation and ordering of materials.
- C. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.
- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.

- E. Circuit Identification: Tag or label conductors as follows:
1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- F. Apply Danger, Warning, Caution and instruction signs as follows:
1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.
 3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
 4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.
 5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- I. Install ARC FLASH WARNING signs on all power distribution equipment per Section 26 05 73.
- J. Circuits with more than 600V: Identify raceway and cable with "DANGER-HIGH VOLTAGE" in black letters 2 (50mm) inches high on orange background at 10'-0 foot intervals.
1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to conduits concealed within wall.
 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.

K. Selective Coordination Label: Install caution signs on all switchboards, distribution panels, panelboards, disconnects, and other equipment with selectively coordinated overcurrent protection devices. Sign at a minimum shall contain:

1. CAUTION: OVERCURRENT DEVICES IN THIS ENCLOSURE ARE SELECTIVELY COORDINATED. EQUIVALENT REPLACEMENTS AND TRIP SETTINGS ARE REQUIRED.

L. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded. [Limit line markers to direct-buried cables.][Install line marker for underground wiring, both direct-buried cables and cables in raceway.]

3.2 BOX LABELING

A. Products:

1. Adhesive labels and field markings.

B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape OR Brother self-laminating vinyl label, letters/numbers.

C. All junction, pull, and connection boxes shall be identified as follows:

1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").
2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").

3.3 CONDUCTOR COLOR CODING

A. Products:

1. All wire and cables shall be color coded by the manufacturer.

B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.

C. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.

D. Conductors shall be color coded as follows:

1. 208Y/120 Volt, 4-Wire:
 - a. A-Phase - Black
 - b. B-Phase - Red
 - c. C-Phase - Blue
 - d. Neutral - White

- e. Ground Bond - Green
2. 480Y/277 Volt, 4-Wire:
 - a. A-Phase - Brown
 - b. B-Phase - Orange
 - c. C-Phase - Yellow
 - d. Neutral - Gray
 - e. Ground Bond - Green
 3. Grounding Conductors:
 - a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.
 4. Cabling for Remote Control, Signal, and Power Limited Circuits:
 - a. Fire Alarm: Red.
 - b. Building Automation Systems and Control: Refer to the Temperature Control Contactor notes located on the mechanical cover sheet.

3.4 EQUIPMENT CONNECTION IDENTIFICATION

- A. Products:
 1. Nameplates and signs.
- B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.
- C. Labeling shall include:
 1. Equipment type and contract documents designation of equipment being served
 2. Voltage and rating of the equipment.
 3. Panel and circuit numbers(s) serving the equipment.

3.5 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

- A. Products:
 1. Nameplates and signs.
- B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards, switchgear, motor control centers, generators, UPS, storage battery disconnects, transfer switches, etc. Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and identify each cubicle of multi-section gear.
 1. Interior Equipment: The identification material shall be engraved plastic-laminated labels.
 2. Labeling shall include:
 - a. Name designation of equipment.
 - b. Voltage of the equipment.
 - c. Name of the upstream equipment.

3.6 INDUSTRIAL CONTROL PANEL IDENTIFICATION

- A. Products:
 - 1. Nameplates and signs.
- B. Provide identification on the front of all industrial control panels and similar equipment. Labels shall be visible on the exterior of the gear and correspond to the one-line and/or schematic diagram nomenclature.
 - 1. Interior equipment: The identification material shall be engraved plastic-laminated labels.
 - 2. Labeling shall include:
 - a. Equipment type and contract documents designation of equipment.
 - b. Voltage, phase, frequency, full load current of each supply circuit
 - c. Name of the upstream equipment

3.7 TRANSFORMER EQUIPMENT IDENTIFICATION

- A. Products:
 - 1. Nameplates and signs.
- B. Provide identification on the front of all transformers. The identification nameplate shall be an engraved plastic-laminated label.
- C. Labeling shall include:
 - 1. Equipment type and contract documents designation of equipment
 - 2. Name of the upstream equipment.
 - 3. Voltage and rating of the equipment.

3.8 ELECTRICAL WORKING CLEARANCE IDENTIFICATION

- A. Products:
 - 1. Safety Yellow paint and custom stencils
- B. Provide custom identification of electrical equipment working clearances in mechanical, electrical, storage, janitorial, and similar non-public areas.
- C. Identification shall include a painted rectangular box (on the finished floor) in front of the electrical equipment to define the code-required working clearance. Provide additional diagonal stripping inside the rectangle box. All painted stripping shall be safety yellow paint with 3 inch wide stripes.
 - 1. Width of area: Width of equipment or as required by code
 - 2. Depth of area: Depth as required by code

END OF SECTION

SECTION 26 05 73

POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. low voltage distribution system power study.
- B. Short-circuit analysis and report.
- C. Selective coordination analysis and report.
- D. Arc-flash hazard analysis and report.

1.2 RELATED SECTIONS

- A. Section 26 05 00 - Basic Electrical Requirements.
- B. Section 26 24 16 - Panelboards.

1.3 SUBMITTALS

- A. The input for the power system study shall be based on the contract documents, with estimated conductor lengths[and field investigation of existing equipment types, sizes, ratings] provided by the Electrical Contractor.
- B. Documentation of the analyses shall be submitted in a single bound electronic (PDF or equal) format and shall accompany the shop drawing submittals for equipment provided under the related work specification sections. The submittal of these related specification sections will not be reviewed without this documentation.

1.4 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC).
- B. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations, latest version.
- C. ANSI Z535.4 - Products Safety Signs and Labels.

1.5 SCOPE

- A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, selective coordination analysis and arc flash hazard analysis.
- B. Contractor is required to provide a fully coordinated system for the electrical system and all other locations indicated on the one line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a selectively coordinated system.

PART 2 - PRODUCTS

2.1 POWER SYSTEM STUDY

- A. Power systems study shall be completed in Power Tools for Windows (PTW) version 9 or later version or pre-approved equivalent program.
- B. Power system studies including, but not limited to short-circuit analysis, selective coordination, and arc-flash analysis are inherently iterative in nature. The initial and subsequent analysis commonly requires engineering evaluation, equipment modification, setting adjustments, and revised analysis report. The power system analysis scope shall not be considered complete until all outstanding engineering, equipment and device setting solutions have been resolved and documented by a final report. The power system study vendor shall provide inclusive bid provisions for the initial, subsequent, final analysis and associated reports.

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS

- A. Provide a complete short-circuit analysis from the utility service to and including the entire building distribution as shown on the drawings.
- B. Analysis shall include the entire distribution system from the point of connection to the utility power source to the distribution panels and branch circuit panelboards.

3.2 ADJUSTMENTS

- A. Manufacturer's authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study. Apply settings prior to placing equipment into operation. When the scope of work or execution includes remodel or phases construction, the contractor shall adjust applicable settings as required prior to each system component placed in operation.
- B. Wherever the arc flash incident energy exceeds Arc Flash Category 2 (i.e. greater than 8 cal/cm²), provide options for adjusting breaker trip times, if possible, to reduce energies to Category 2 or below.

END OF SECTION

SECTION 26 09 33

LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Line and low voltage standalone lighting controls.
- B. Automatic load control relay (ALCR20).
- C. Time switches.

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 51 19 LED Lighting
 - 2. 26 52 15 Emergency Lighting Inverter
 - 3. Electrical Drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 RELATED WORK

- A. Section 01 91 00 - Commissioning.
- B. Section 26 51 00 - Lighting.

1.4 REFERENCES

- A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference.
- B. FS W S 896 Switch, Toggle.
- C. NEMA WD 1 - General Color Requirements for Wiring Devices.
- D. NEMA WD 7 - Occupancy Motion Sensors.
- E. NFPA 70 - National Electrical Code (NEC).
- F. UL Standard 916 Energy Management Equipment.
- G. UL 924 - Emergency Lighting and Power Equipment.

- H. UL 1472 - Solid-State Dimming Controls.

1.5 SUBMITTALS

- A. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, warranty, system software requirements[, and roles and responsibilities of all persons and groups involved in installation, execution, and commissioning].
- B. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.
- C. Submit a list of devices and equipment that will be installed for each sequence of operation.
- D. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, timeclocks, photocells, dimmers, relays, low voltage switches, occupancy sensors, control stations, dimmer panels, relay panels, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.

1.6 EXTRA STOCK

- A. Provide extra stock under provisions of Section 26 05 00.
- B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.
- C. Relays and Dimmer Modules: Five (5) percent of quantity installed. Minimum of two (2) of each size and type.
- D. Control Stations: One (1) of each configuration and type, except for LCD touch screens requiring factory setup prior to installation.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit project record documents under provisions of Section 26 05 00.
- B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:
 - 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
 - 2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
 - 3. Replacement part numbers for all system components.

- B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.
- C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

1.9 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying lighting design documents describe the minimum material quality, required features, and operational requirements of the lighting control system (LCS). These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the performance required of the system, as presented in these documents, the Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring, and programming required for a complete and operational system.
- B. Provide an integrated lighting controls system consisting of line-voltage (277V) contactors, timeclocks, photocells, panels, power supplies, controllers, sensors, relays, switches, devices, wiring, etc. necessary to provide a fully functional lighting control system. Contractor is responsible for confirming that all components and luminaires interoperate as a single system.
 - 1. Drawings: The drawings include locations of control devices, sensors, and control zones/circuits. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted with the shop drawings.
 - 2. Provide programming for the timeclocks to control the lighting fixtures per NNEPRA and Wells PD's preferred schedule.
- C. The following control types and features are acceptable. Acceptable control locations are shown on the drawings.
 - 1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.
 - 2. Distributed Control: Control equipment is in the space/zone being controlled; not reliant on centralized controllers.
 - a. All locations shall have the ability to be networked for remote control and monitoring, but network connections are not required.
 - 3. Centralized Control: Control equipment is in a central location serving multiple spaces/zones and provides time-based schedule and remote control.
 - a. The lighting control system (LCS) shall be networked with BACnet IP capabilities.

1.10 MOCKUP

- A. Provide and install luminaires with power and control connections in mockup rooms as identified in Division 1. Approved luminaires and controls in mockup may be reused as part of complete work if in original condition.

1.11 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative. Project closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Division 1 for detailed commissioning requirements.
- B. The Contractor shall provide all services necessary for compliance with the IECC Section C408 Commissioning. The commissioning shall include, but not be limited to, a commissioning plan, preliminary commissioning report, construction documents, manuals, final commissioning report, and lighting system functional testing.
- C. This project will have selected building systems commissioned. The Contractor is responsible to execute commissioning. The commissioning process, equipment, and systems to be commissioned are defined in Division 1.
- D. The Contractor shall notify the Architect/Engineer and Owner's Representative ten (10) working days prior to scheduled commissioning date.
- E. The commissioning process requires meeting attendance. Refer to Division 1 for meeting requirements.
- F. The system shall be functionally tested by a factory-authorized engineer and comply with the Sequence of Operation. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system.

1.12 WARRANTY

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.
- B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROLS

- A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications. Lighting control switches, systems, and components shall be listed.
- B. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

2.2 LIGHTING CONTROL STATION

- A. The lighting control station shall contain the controls required by the lighting sequence of operation in a common coverplate. The controls may consist of switches, dimmers, occupancy sensors, pushbuttons, etc.
 - 1. In spaces where the wall control station is shown in multiple locations, the sequence of operation shall be the same at all locations, unless noted otherwise.
 - 2. The controls supplier shall prepare control station shop drawings showing arrangement of controls, dimensioned elevations, wiring diagram, and recommended backboxes. The shop drawing submittal should be identified with the lighting sequence that the station provides. Submit data sheets on the switches, dimmers, sensors, buttons, etc. contained in the control station.

2.3 WALL SWITCHES

- A. Refer to Electrical Symbols List for device type.
- B. SW-1P; Single Pole Switch:
 - 1. Single throw, 120/277-volt, 20-amp maintained contact. Rocker handle, side and back wired.
 - 2. Manufacturers:
 - a. Hubbell DS120
 - b. Leviton 5621
 - c. Pass & Seymour 2621
 - d. Cooper 7601.

| Lighting Load | Load A | Load B |
|---------------|--------|--------|
| Step 1: | On | Off |
| Step 2: | Off | On |
| Step 3: | On | On |
| Step 4: | Off | Off |

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

- A. Schedule a pre-construction meeting with the controls representative, installing contractor, Architect/Engineer, and Owner to explain the proposed lighting control centralized, wireless, and distributed systems.

3.2 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. All wiring shall be installed in conduit.
- C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

3.4 SUPPORT SERVICES

A. System Startup:

1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.

B. Testing:

1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Owner. The following procedures shall be performed at a minimum:
 - a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
 - b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.
 - c. Confirm that schedules and time controls are configured to meet specified performance criteria and Owner's operating requirements.
3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.
4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.
 - a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
 - b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent areas.

C. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.

2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two (2) weeks after initial training.

D. Documentation:

1. Manufacturer shall provide system documentation including:
 - a. System one-line showing all panels, number and type of control stations and sensors, communication line, and network or BMS/BAS interface unit.
 - b. Drawings for each panel showing hardware configuration and numbering.
 - c. Panel wiring schedules.
 - d. Typical diagrams for each component.

3.5 SYSTEM COMMISSIONING

- A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 01 09 00, General Commissioning, for further details.
- B. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Agent. Refer to Section 01 09 00, General Commissioning, for system verification tests and commissioning requirements.
- C. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 01 09 00, General Commissioning, for Contractor training requirements.

END OF SECTION

SECTION 26 22 00

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 REFERENCES

- A. NEMA - ST 1 - Specialty Transformers.
- B. NEMA ST 20 - Dry Type Transformers for General Applications.
- C. ANSI/IEEE C57.12.01 - General Requirements for Dry Type Distribution and Power Transformers.
- D. ANSI/IEEE C57.12.91 - Test Code for Dry Type Distribution and Power Transformers.
- E. Department of Energy 10 CFR Part 431 - Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.
- F. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
- G. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency.

1.2 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 26 05 00.
- B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 DRY TYPE TWO WINDING TRANSFORMERS

- A. Acceptable Manufacturers:
 - 1. Square D 7400 EX##T / SK300##KB Series
 - 2. Eaton V48M / H48M / B48M Series
 - 3. ABB 9T Series
 - 4. Hammond SG / SMK Series
 - 5. Siemens 3F3 Series
- B. Dry Type Transformers: NEMA ST 20, factory-assembled, air-cooled dry type transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.

C. Insulation system and average winding temperature rise for rated KVA as follows:

| Ratings | Class | Rise (degree C) |
|--------------|-------|--------------------------|
| Less than 15 | 185 | As shown on the drawings |
| or higher | 220 | As shown on the drawings |

D. Case temperature shall not exceed 40°C rise above ambient at its warmest point.

E. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

F. Winding Taps, Transformers 15 KVA and Larger: Two (2) 2-1/2% below and two (2) 2-1/2% above rated voltage, full capacity taps on primary winding.

G. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

| | Average Sound Level, Decibels | | | |
|------------------------------|--|--------------------------------|----------------------------|--------------------|
| | Self-Cooled Ventilated | | | Self-Cooled Sealed |
| Equivalent Winding kVA Range | K-Factor = 1 K-Factor = 4 K-Factor = 9 | K-Factor = 13 K-Factor = 20 | Forced Air w/ Fans Running | |
| 0-9 | 40 | 40 | 67 | 45 |
| 9.01-30.00 | 45 | 45 | 67 | 50 |
| 30.01-50.00 | 45 | 48 | 67 | 50 |
| 50.01-150.00 | 50 | 53 | 67 | 55 |
| 150.01-300.00 | 55 | 58 | 67 | 57 |
| 300.01-500.00 | 60 | 63 | 67 | 59 |
| 500.01-700.00 | 62 | 65 | 67 | 61 |
| 700.00-1000.00 | 64 | 67 | 67 | 63 |

H. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

J. Coil Conductors: Continuous windings with terminations brazed or welded.

K. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: NEMA TP 3; Include transformer connection data and overload capacity based on rated allowable temperature rise.

| KVA Rating | Insulation Class | Temperature Rise (degree C) |
|------------|------------------|-----------------------------|
| 0.25-2 | 185 | 80 |

3-7.5 220 115

| | | |
|------------|------------------|-----------------------------|
| KVA Rating | Insulation Class | Temperature Rise (degree C) |
| 0.25-2 | 185 | 80 |
| 3-7.5 | 220 | 115 |

| | | |
|------------|------------------|-----------------------------|
| KVA Rating | Insulation Class | Temperature Rise (degree C) |
| 1-9 | 185 | 115 |
| 10-500 | 220 | 130 |

| | Average Sound Level, Decibels | | | |
|---------------------------------|--|--------------------------------|----------------------------------|--------------------|
| | Self-Cooled Ventilated | | | Self-Cooled Sealed |
| Equivalent Winding kVA Range | K-Factor = 1 K-Factor = 4 K-Factor = 9 | K-Factor = 13 K-Factor = 20 | Forced Air w/ Fans Running | |
| 0-9 | 40 | 40 | 67 | 45 |
| 9.01-30.00 | 45 | 45 | 67 | 50 |
| 30.01-50.00 | 45 | 48 | 67 | 50 |
| 50.01-150.00 | 50 | 53 | 67 | 55 |
| 150.01-300.00 | 55 | 58 | 67 | 57 |
| 300.01-500.00 | 60 | 63 | 67 | 59 |
| 500.01-700.00 | 62 | 65 | 67 | 61 |
| 700.00-1000.00 | 64 | 67 | 67 | 63 |

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on four 3"x3"x1/2" thick, 50 durometer rubber vibration isolating pads suitable for isolating the transformer noise from the building structure.
- D. Ventilated transformers: Provide factory label on horizontal surface to prohibit storage on top, front, or adjacent to transformer.
- E. Install primary, secondary, and grounding electrode conductors using factory or field fabricated enclosure entries. Conductors shall not be routed through ventilated openings.

3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 RELATED SECTIONS AND WORK

- A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.

1.2 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA FU 1 - Low voltage cartridge fuses.
- C. NEMA KS 1 - Enclosed Switches.
- D. NEMA PB 1 - Panelboards.
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.
- G. UL 248 - Low-Voltage Fuses.
- H. UL 67 - Panelboards.

1.3 SUBMITTALS

- A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Selective Coordination Study: Submit study to prove that all essential electrical systems, emergency systems and legally required standby system panelboards are selectively coordinated with all supply side overcurrent protective devices.
- D. Arc Energy Reduction Documentation: Submit documentation to demonstrate the arc energy reduction system is set to operate at a value below the available arcing current.
- E. Refurbished branch panel enclosure documentation for new branch panelboards installed in existing enclosures.
- F. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.4 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.
- B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.
- C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

- A. Definitions:
 - 1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.
 - 2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.
- B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

- A. General
 - 1. Manufacturers:
 - a. Square D QMB, I-Line
 - b. ABB ReliaGear Entelleon
 - c. Siemens F2, P4
 - d. Eaton PRL4, PRL5
- B. Panelboards: NEMA PB 1; type as shown on the drawings.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with[concealed trim clamps and] hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.
- G. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

- H. Molded Case Circuit Breakers with Current Limiters: Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

2.3 BRANCH CIRCUIT PANELBOARDS

- A. General
 - 1. Manufacturers:
 - a. Square D NQ, NF
 - b. ABB A Series
 - c. Siemens P1
 - d. Eaton PRL1, PRL2
- B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.
- G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

2.4 ACCESSORIES

- A. Provide REQUIRED accessories as described below. Provide SCHEDULED accessories when listed with plan schedules. Refer to plan schedules for additional requirements.
- B. Barriers: Provide finger safe barriers for lineside uninsulated and ungrounded terminations and components which remain energized when the main disconnecting device is 'open'. REQUIRED
- C. Barriers (Service Equipment): Provide solid barriers for lineside uninsulated and ungrounded terminations and components which remain energized when the main disconnecting device is 'open'. REQUIRED
- D. Transformer Disconnect Lockable Hasp: Provide circuit breakers, fused switches, and disconnects serving transformers with a lockable padlock hasp capable of being locked in the open/closed position. REQUIRED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Height: 6 feet to handle of highest device.

- B. Provide filler plates for unused spaces in panelboards.
- C. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.
- D. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.

3.2 REFURBISHED ENCLOSURES - NEW PANELBOARDS

- A. Existing panelboard enclosures may be reused to house new panelboards pending documented verification of the following provided with the applicable new equipment submittals.
 - 1. New branch panelboard is listed for the existing enclosure or application.
 - 2. Existing enclosure and new equipment is field evaluated by the manufacturer or nationally recognized testing laboratory for the available fault current, condition, and application.
 - 3. Authority Having Jurisdiction AHJ approval.

END OF SECTION

SECTION 26 28 16

DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches.
- B. Non-fusible switches.
- C. Molded case circuit switches.
- D. Motor disconnect switch.
- E. Elevator Service Disconnect Switch.
- F. Enclosures.

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series
 - 2. Eaton DH Series
 - 3. ABB TH Series
 - 4. Siemens HNF / HF Series

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D
 - 2. Eaton
 - 3. ABB
 - 4. Siemens
- B. All exterior equipment shall be NEMA-3R.

2.3 MOTOR DISCONNECT SWITCH

- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series
 - 2. Eaton r5 Series
 - 3. ABB ML Series
 - 4. Siemens LBR Series
- B. Ground lug connection provided in enclosure.
- C. Listed UL 508 suitable for motor control.

2.4 ELEVATOR SERVICE DISCONNECT SWITCH

- A. Acceptable Manufacturers:
 - 1. Eaton Bussmann PS Series
 - 2. Mersen ES Series
 - 3. Littlefuse LPS Series
- B. Elevator Service Fused Disconnect Switch: Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool, with lockable handle, ratings per drawing schedule, 120 volt shut trip, two field convertible mechanically interlocked form C auxiliary contacts, shunt trip voltage monitor relay, integral control transformer, Pilot Light "on", neutral bar/lug, NEMA 1 enclosure, minimum 100K SCCR, UL Listed.
- C. Provide with fire alarm interface relays for:
 - 1. Elevator Recall
 - 2. Elevator Alternative Floor Recall
 - 3. Elevator Shut Down Sequence
 - 4. Fire Fighter's Cab Visual Alarm
 - 5. Elevator Hoistway Damper
- D. Accessories: Provide the following accessories for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on the drawings.
- B. Install fuses in fusible disconnect switches.
- C. Field coordinate installation with other contractors and equipment to maintain code required working space requirements.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ELEVATOR SERVICE DISCONNECT SWITCH

- A. Coordinate installation with elevator requirements and contractor.
- B. Coordinate installation with fire alarm contractor.

3.3 ADJUSTING

- A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION

SECTION 26 51 19

LED LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories.
- B. Exterior luminaires and accessories.
- C. LED emergency lighting units.
- D. Emergency exit signs.
- E. Emergency inverter for LED light engines (individual luminaires - integral).
- F. Lighting poles.

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 09 33 Lighting Control Systems
 - a. Automatic load control relay (ALCR) (individual luminaire - integral) (ALCR3)
 - 2. 26 52 15 Emergency Lighting Inverter
 - 3. Electrical drawings: Plans, luminaire schedules, lighting control, diagrams, and details.

1.3 REFERENCES

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products.
- B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement.
- C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment.
- D. NFPA 70E - National Electrical Safety Code.
- E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System.

- F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products.
- G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
- H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED.
- I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary).
- J. UL 924 - Standard for Emergency Lighting and Power Equipment.
- K. UL676 Standard for Underwater Luminaires and Submersible Junction Box.
- L. Project site classification as defined in IESNA RP-33 LZ.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Basic Requirements of Submittal:
 1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
 2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
 3. Include outline drawings, support points, weights, and accessory information for each luminaire.
 4. Submit manufacturer origin of LED chipset and driver.
- C. LED Lighting - Control Compatibility Submittal:
 1. Submit lighting control capability data for each LED luminaire. The submittal shall clearly identify device data proposed by the Contractor and approved by the luminaire manufacturer for dimming, switching, addressable, wireless, and similar control characteristics.

1.5 EXTRA STOCK

- A. LED Light Engines or Modules: <Insert> percent of quantity installed, minimum one (1) of each size and type of field replaceable light engine or module. Provide field replacement installation instructions.
- B. Exit Signs: Provide 5 additional exit sign luminaires complete with labor, conduit, and wire. Additional exit luminaires shall be located per the Architect/Engineer or provided as attic stock when a location is not defined prior to Owner occupancy. When multiple exit signs are scheduled, the quantity listed above shall represent each type listed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.
- C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.7 MOCKUP

- A. Provide and install luminaires with power and control connections in mockup rooms as identified in Division 1. Approved luminaires in mockup may be reused as part of complete work if in original condition.

1.8 WARRANTY

- A. The warranty period begins at the date of Substantial Completion.
- B. LED Light Engines and Drivers:
 - 1. LED Drivers and Dimming Drivers: Five (5) years
 - 2. Light Emitting Diode (LED) Light Engines: Five (5) years
- C. Emergency Lighting Units and Exit Signs:
 - 1. Emergency Lighting Units: Three (3) year, non-prorated
 - 2. Exit Signs: Three (3) year, non-prorated
 - 3. Emergency Unit and Exit Sign Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for ten (10) years under normal conditions.
- D. Emergency Drivers:
 - 1. Emergency LED Driver: Five (5) years
- E. Emergency Inverter for LED Light Engines:
 - 1. Emergency Inverter and Battery: Sealed nickel cadmium five (5) year, non-prorated.
- F. Automatic Load Control Relay (ALCR): Five (5) year.
- G. Pole Finish: Three (3) year warranty of pole color and finish.

1.9 REGULATORY REQUIREMENTS

- A. Conform to NFPA 101 for installation requirements.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.
- B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

- C. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.
- D. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified. Verify suspension length prior to submittal.
- E. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled. Provide ingress protection (IP) rating when scheduled.
- B. Provide low temperature LED drivers, with reliable starting to -20°F.
- C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.
- D. Exterior LED luminaires shall contain separate, easily accessible and replaceable Category C surge protection device.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

- A. LED Driver:
 1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of [10][20]%. Driver shall have a voltage fluctuation tolerance of +/- 10%.
 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
 3. Driver shall have a minimum of 50,000 hours rated life.
 4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.

2.4 LED EMERGENCY LIGHTING UNITS

- A. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- B. Battery: Maintenance free lead calcium type, with 120 minute capacity to supply the connected lamp load.
- C. Charger: Dual-rate solid state current limiting charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charged within 168 hours. Low voltage disconnect to prevent deep discharge of battery.
- D. LED Lamp Wattage: As scheduled on luminaire schedule.

- E. Remote Lamps: Match LED lamps on unit.
- F. Indicators: Provide lamps to indicate AC ON and RECHARGING.[Provide voltmeter.]
- G. Self-Diagnostics and Testing:
 1. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit, or emergency lamps shall be detected and visually indicated.

2.5 EMERGENCY EXIT SIGNS

- A. Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.
- B. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all requirements of NFPA 101.
- C. Self-Diagnostics and Testing:
 1. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any malfunction of battery, charger, transfer circuit, or emergency lamps shall be detected and visually indicated.

2.6 EMERGENCY INVERTER FOR LED LIGHT ENGINES (INDIVIDUAL LUMINAIRES - INTEGRAL)

- A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for factory or field installation, indoor and damp locations, 32°F to 122°F operating temperature. Compatible with switched, dimmed, and unswitched lighting controls. Compatible with LED light engines. The inverter output shall be sinusoidal with solid-state low voltage disconnect circuit.
- B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 120 minutes of emergency operation at full lumen and wattage output, with 24-hour recharge time. Refer to Luminaire Schedule for lumen and wattage requirements.
- C. Self-Test Diagnostics and Testing: Provide with listed automatic monthly self-test diagnostics.

2.7 LIGHTING POLES

- A. Manufacturers:
 1. Manufacturer of luminaire (metallic pole)
 2. Valmont Poles (metallic pole)
 3. U.S. Pole Company (metallic pole)
 4. KW Industries (metallic pole)
- B. Metal Poles: Round steel lighting pole with anchor base.
- C. Wind Load: 110 MPH velocity, with 1.14 percent three-second gust factor with luminaires and brackets mounted.

- D. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.
 - 1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:
 - a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
 - b. Luminaires 56 lbs or greater: Provide a minimum of four (4) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires. Support luminaire independent of the ceiling system.
 - c. Luminaires larger than eight square feet (8 ft²): Support luminaire independent of the ceiling system.
- B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.
- C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
- D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.
- E. Provide seismic bracing of luminaires per IBC Chapter 16. Design pendant luminaires on a component seismic coefficient (C_c) of 0.67. Design vertical supports with a factor of safety of 4.0. Contractor shall verify the Seismic Hazard Exposure Group and Performance Criteria Factor.
- F. Install lamps in lamp holders of luminaires.
- G. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.
- H. Industrial Pendant Luminaires: Use power hook hangers rated 500 pounds minimum or provide safety chain between driver and structure. Provide safety chain between reflector and driver.
- I. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

- J. Embedded Luminaire Poles: Depth as indicated. Install plumb.
- K. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES

- A. The Contractor shall provide temporary construction lighting per the requirements of Division 1.
- B. The project luminaires shown on the construction documents shall not be used for temporary construction purposes without providing a plan for Owner approval that addresses energy and luminaire operating hours.

3.3 AUTOMATIC LOAD CONTROL RELAYS

- A. Factory or field installation per manufacturer requirements.
- B. Remote Test Switch: Provide connection to remote test switch.
- C. Fire Alarm Override: Provide connection to addressable fire alarm relay.

3.4 EMERGENCY LIGHTING UNITS AND EXIT SIGNS

- A. Aim directional lamp heads as directed.
- B. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.5 RELAMPING

- A. Replace failed LED light engine modules or arrays at completion of work.

3.6 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

3.7 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

END OF SECTION

SECTION 26 52 15

EMERGENCY LIGHTING INVERTER

PART 1 - GENERAL

1.1 REFERENCE AND REGULATORY

- A. UL924 - Standard Emergency Lighting and Power Equipment.
- B. UL924A - Auxiliary Lighting.
- C. NFPA 101 - Life Safety Code.
- D. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems.
- E. ANSI C62.41 (IEEE 587).
- F. ANSI C62.42.45 (Cat A & B).
- G. OSHA - Occupational Safety and Health Administration.

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 09 33 Lighting Controls
 - 2. 26 51 19 LED Lighting
 - 3. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.

1.5 SYSTEM DESCRIPTION

- A. System Configuration: Emergency lighting inverter, line interactive, solid-state power supply with cabinet enclosure.
- B. Operating Sequence: When utility power is available, it is supplied by the normal power source. When utility power fails, the load is transferred to the emergency battery. When utility is restored, load is retransferred and battery charger restores battery charge.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 05 00.
- B. Include battery maintenance and unit testing procedures.

1.7 WARRANTY

- A. Emergency Lighting Inverter: Five (5) year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Myers Emergency Power System Illuminator Series.
- B. Signify Chloride HC Series.
- C. Acuity Lithonia Lighting Iota IIS Series.
- D. Perfect Power Systems Power Ride Series.

2.2 EMERGENCY LIGHTING INVERTER

- A. Emergency lighting inverter, line interactive, solid-state power supply with cabinet enclosure. The system shall be suitable LED, and fluorescent lamp sources without extinguishing the illumination arc upon load transfer. UL924 listed latest edition.
- B. Input Voltage: 277 volts, 60 Hertz, single phase.
- C. Output Voltage: 277.
- D. Battery Operating Time: 120 minutes at full load and within output voltage limits.
- E. Recharge Time: 24 hours maximum after full discharge.
- F. Inverter Output:
 - 1. Voltage Stability: +/- 5%
 - 2. Frequency: +/- 1%
 - 3. Harmonic Distortion: 10% maximum at full load
 - 4. Crest Factor: 3 to 1

- G. Battery: Lead calcium, sealed maintenance-free type. Low voltage battery disconnect protects the battery from "deep discharge" during prolonged power outages.
- H. Charger: Designed to maintain battery in full-charge condition during normal conditions.
- I. Self-Test and Self-Diagnostics: Provide unit with self-test and self-diagnostics capability.
- J. System power capacity shall be sized per drawings or larger.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide interconnection between cabinets.
- B. Branch Circuit: The manufacturer recommended input circuit breaker size may vary between manufacturers. Provide branch circuit breaker and wire size per manufacturer recommendations in lieu of the scheduled sizes when applicable.

END OF SECTION

SECTION 27 05 28

INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 26 05 33 - Conduit and Boxes.
- B. Section 26 05 35 – Surface Raceways.

1.2 QUALITY ASSURANCE

- A. Refer to Section 26 05 00 – Basic Electrical Requirements.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA VE 2-2000 - Cable Tray Installation Guidelines

1.4 DRAWINGS

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Conduits routes and rough-in of junction boxes shall be coordinated with architect and engineer. Above-ceiling spaces are limited; surface-mounted conduit routes and junction box locations shall be approved by designers prior to installation.
- B. The bridge design includes dedicated cavities for passage of conduits, refer to drawings.
- C. Conduits stubbing up to devices on ceilings and walls shall be concealed inside walls or mullions wherever possible.

3.2 ATTACHMENT TO METAL DECKING

- A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

SECTION 27 05 43

EXTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing exterior racks, ladders, conduits, sleeves, innerduct, etc. for an exterior cabling plant.

1.2 REFERENCES

- A. Section 27 05 00 - Basic Communications Systems Requirements.
- B. AASHTO HS-20 - Standard Specification for Highway Bridges.
- C. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- D. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.
- E. ASTM A48 - Gray Iron Castings.
- F. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.3 REGULATORY REQUIREMENTS

- A. Equipment and material shall be UL (Underwriters Laboratory) listed and labeled.

PART 2 - PRODUCTS

| ASTM Test | Description | Values HDPE |
|-----------|---|---------------------------------|
| D-1505 | Density g/CM 3 | Less than 0.941 |
| D-1238 | Melt Index, g/10 min Condition E | Greater than 0.55 grams/10 min. |
| D-638 | Tensile Strength at yield (psi) | 3000 min. |
| D-1693 | Environmental Stress Crack Resistance Condition B, F 20 | 96 hrs. |
| D-790 | Flexural Modulus, MPa (psi) | Less than 80,000 |
| D-746 | Brittleness Temperature | -75°C Max |

| SIZE | OD | ID |
|--------|---------------|--------------|
| 1" | 1.375" (Max.) | 1.0" (Min.) |
| 1-1/4" | 1.67" (Max.) | 1.25" (Min.) |
| 1-1/2" | 2.0" (Max.) | 1.5" (Min.) |

PART 3 - EXECUTION

3.1 INSTALLATION - DUCTBANK

- A. Make duct bank installations and penetrations through foundation walls watertight.
- B. Top of duct banks shall be a minimum of 24 inches below grade, unless otherwise indicated on drawings.
- C. Assemble duct banks using non-magnetic saddles, spacers and separators. Position separators to provide 3-inch minimum separation between the outer surfaces of the ducts.
- D. Transition from non-metallic to galvanized rigid steel conduit where duct banks enter buildings, manholes, and hand-holes.
- E. Where ducts enter structures such as manholes, hand-holes, pullboxes and buildings, terminate the ducts in suitable end bells.
- F. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3-inches per 100 feet.
- G. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand, or gravel have been left in the duct.
- H. Plug and seal empty spare ducts entering buildings and structures. Seal watertight all ducts in use entering buildings and structures.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with their work.
- B. Excavation:
 - 1. Excavations for trenches shall be excavated to proper dimensions to permit installation and inspection of work.
 - 2. Where excavations are carried in error below indicated levels, thoroughly compacted sand-gravel fill, shall be placed in such excess excavations.
 - 3. Excavations shall be protected against frost action and freezing.
 - 4. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation be undermined.
 - 5. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc., shall be borne by the bidder.
 - 6. In the case where the trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

7. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.
 8. Mechanical excavation of the trench to line and grade of the conduit, unless otherwise indicated on the drawings.
- C. Dewatering:
1. The Contractor shall be responsible for the furnishing, installation, operation and removal of all dewatering pumps and lines necessary to keep the excavation free of water at all times.
- D. Underground Obstructions:
1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locators can be found by calling 811. The Contractor is responsible for obtaining all utility locates for all trades on the project to determine obstructions indicated. The Contractor shall use great care in installing in the vicinity of underground obstruction.
- E. Fill and Backfilling:
1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.
 2. The Contractor shall provide the necessary sand for backfilling.
 3. Dispose of the excess excavated earth as directed.
 4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials, frozen earth, debris or earth with an exceptionally high void content, and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed.
 5. All trenches shall be backfilled immediately after installation of conduit, unless other protection is directed.
 6. All conduit shall be laid on a compacted bed of sand at least 3" deep. Backfill around the conduit with sand, spread in 6" layers, then compact each layer.
 7. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. Native soil materials may be used as backfill if approved by the Geotechnical Engineer. All other conduit shall have sand backfill to 6" above the top of the conduit.
 8. The backfilling above the sand shall be placed in uniform layers not exceeding 6" in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.
 9. Install a warning tape approximately 12 inches below finished grade over all underground duct banks. The identifying warning tape shall be as specified above.
 10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
 11. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

3.3 RESTORATION REQUIREMENTS

- A. Where soil and sod has been removed, it shall be replaced as soon as possible after backfilling is completed. All areas disturbed by work shall be restored to their original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, or mulching,

END OF SECTION

SECTION 28 05 00

BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make the portion of the security systems a finished and working system.
- C. Separate contracts will be awarded for the following work.
- D. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- E. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- F. Description of systems include but are not limited to the following:
 - 1. Electronic access control system.
 - 2. Electronic intrusion detection system.
 - 3. Video surveillance.
 - 4. Fire detection and alarm.
 - 5. Low voltage security wiring (less than +120VAC) as specified and required for proper system control and communications.
 - 6. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
 - 7. Firestopping of penetrations of fire-rated construction as described in Section 26 05 03.

1.3 OWNER FURNISHED PRODUCTS

- A. <Insert>.

1.4 WORK SEQUENCE

- A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during non-occupied hours. The Owner shall reserve the right to set policy as to when restricted construction hours will be required.
- B. Itemize all work and list associated hours and pay scale for each item.

1.5 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
 - 1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
 - 2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
 - 3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.
 - 4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.
- C. General:
 - 1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to security systems including back boxes, conduit, [cable tray,]power wiring and low voltage security wiring. The prime contractor is responsible for all divisions of work.
 - 2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.
 - 3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.
 - 4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.

5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Electrical Busduct
 - e. Cable Trays, including 12" access space
 - f. Sprinkler Piping and other Piping
 - g. Conduit and Wireway
 - h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Security Systems grounding and bonding.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:

1. Assumes all responsibility for the low voltage security wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of security equipment which is required to be bonded to the telecommunications bonding system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other contractors to determine a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

- b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
 3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the GC.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:

- 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

| | |
|-----------------------------|---|
| Referenced Specification | |
| Section | Submittal Item |
| 26 05 03 | Through-Penetration Firestopping |
| 28 26 05 | Rescue Assistance Communication System |

1.7 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
 1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
 3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
 - a. Security systems:
 - 1) Surveillance

- 2) Access control
- 3) Intrusion
- 4) Infant abduction

- D. Update Schedule of Values when:
1. Indicated by Architect/Engineer.
 2. Change of subcontractor or supplier occurs.
 3. Change of product or equipment occurs.

1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.9 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:
 1. Firestopping, including mechanical firestop systems.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.11 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.12 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.

- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.13 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.14 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

- 2.1 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.
- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

- A. General:
1. Refer to specific Division 28 sections for further requirements.
 2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by **FACTORY PERSONNEL** in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- F. Refer to the individual specification sections for minimum hours of instruction time for each system.
- G. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.
2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.5 SYSTEM STARTING AND ADJUSTING

- A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record actual routing of all conduits sized 2" or larger.

- E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.7 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

- 1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
- 2. All mechanical firestop products are installed and all other penetrations have been sealed.
- 3. All CCTV cameras, mounts, cabling and all headend equipment are installed, programmed and operational.
- 4. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____

By: _____

Requested Observation Date _____

Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

END OF SECTION

SECTION 28 26 05

RESCUE ASSISTANCE COMMUNICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. General:

1. Furnish all labor, materials, tools, equipment and services for a complete area of Rescue Assistance Communication System as indicated in Contract Documents and as required by the American with Disabilities Accessibility Guidelines (ADAAG).
2. Completely coordinate with work of all other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 OPERATION

- A. General: Provide two way audible/visual communication between a master annunciator station and the area of rescue assistance communication stations.

1.3 SYSTEM OPERATION

- A. The master annunciator panel shall be located in the Fire Command Center. Calls placed between rescue assistance stations and the master annunciator panel shall be identifiable at the master annunciator panel to indicate which station has placed a call. The master annunciator panel shall include both a handset and a speakerphone to allow two-way communication to each station. Upon activation of an emergency pushbutton at call stations, a call will automatically be placed to the master annunciator panel. If no one answers the call, it shall automatically dial a secondary location to a continuously manned location.
- B. Rescue assistance stations shall be located on each level within elevator lobbies and in outdoor areas of refuge.
- C. Call stations shall provide audible and visual indication that a call has been placed.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all components and complete system as indicated and in accord with manufacturer's recommendations and instructions.
- B. All cabling shall be installed to meet the applicable requirements for pathway survivability. Cabling installation shall consist of the following:

1. 2-hour fire rated circuit integrity (CI) cable
 2. 2-hour fire rated cable system
 3. 2-hour fire rated enclosure or protected area
- C. Contractor is to provide and install a typewritten list in a Plexiglas frame permanently fastened to the wall next to the master rescue assistance annunciator panel to indicate the building location of each of the remote area of rescue assistance call stations and to which annunciator zone and LED they correspond.
- D. Contractor is to provide a typewritten list of area of rescue assistance communication instructions in a Plexiglas frame permanently fastened to the wall next to each remote switch and the annunciator panel to explain the operation of the system.
- E. Provide code-required signage acceptable to the Authority Having Jurisdiction at each call station location.

3.2 SYSTEM TESTING

- A. Test each component and complete system for proper operation, including all modes. Perform correctional work when required. Testing shall be done in the presence of the Owner's Representative(s).

3.3 OWNER PERSONNEL INSTRUCTION

- A. Instruct maintenance and staff personnel in complete operation, including actual staff use of system, by authorized distributor personnel. Arrange timing of the session in writing to best coordinate with Owner's working hours. Allow four (4) hours of training. This training session shall be videotaped by the Contractor.

3.4 SPARE PARTS

- A. Provide one spare remote station.

END OF SECTION

SECTION 28 31 00

FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.
- B. Section 28 05 37 - Distributed Antenna System (DAS) for Public Safety Networks.

1.2 REFERENCES

- A. ASME A17.1 - Safety Code for Elevators and Escalators.
- B. NFPA 20 - Standard for Centrifugal Fire Pumps.
- C. NFPA 70 - National Electrical Code (NEC).
- D. NFPA 72 - National Fire Alarm and Signaling Code.
- E. NFPA 101 - Life Safety Code.
- F. UL 2017 - General Purpose Signaling Devices and Systems.
- G. UL 217 / 268 - Standard for Smoke Alarms / Smoke Detectors for Fire Alarm Systems.
- H. UL 2572 - Control and Communication Units for Mass Notification Systems.

1.3 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.
 - a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.
 - b. Notification Appliances: Speakers, speaker strobes, and strobes.
 - 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet minimum of one (1) set each and shall turn over to the Owner upon completion.
 - 3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."
 - 4. Portable Firefighter Emergency Handset Phones: Provide 2. Locate in the electrical room with the main fire alarm panel.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.

1.5 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.6 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, voice evacuation equipment, emergency communication systems, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Interfacing the Existing Fire Alarm System: Provide all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to interface the existing fire alarm system with the new fire alarm system. This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, auxiliary control and related devices such as, door holders and their control, smoke damper control, fan shutdown, etc. The existing fire alarm system shall be interfaced with the new fire alarm system such that the existing fire alarm system's functionality, integrity and annunciation shall be equivalent to pre-construction conditions, unless noted otherwise. The functionality and integrity shall be maintained during construction. The entire system shall be able to be completely reset from any single reset location point. The entire system shall be annunciated at any annunciation location.

- D. Extending the Existing Fire Alarm System: The existing control panel shall remain and shall be operational throughout construction. The system shall only be disabled to make new connections and to modify the programming. A fire watch shall be provided for all areas affected during outages. All system outages must be scheduled with the Owner at least one week prior. Individual devices may be disabled as needed based on construction activities to reduce the potential for false alarms, but all devices must be operational when the Contractor is not physically on site. New initiating devices may be connected to the existing signaling line circuits where capacity is available. Provide additional signaling line circuits as needed based on existing and new device quantity, including replacement of existing panel components. Provide new notification circuits to serve the new devices, including all necessary power supplies, amplifiers, batteries, and 120-volt input circuits. All new devices shall be programmed to provide the same sequence of operation as the existing devices of the same type, unless noted otherwise.
- E. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.
- F. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and self-restoring network communications. Each building shall contain an independent building fire alarm / voice communications system, with full command and control from the campus command center. In no case shall read only network annunciation be acceptable as the only networking function.
- G. In-Building Network: A complete fire alarm system network shall be provided. Provide quantity of control panels as indicated on the drawings. The network shall be a Style 7 token ring, peer-to-peer network. The network shall be characterized by simultaneous or sequential transmission, or both, and reception of multiple signals on a signaling line circuit or communication channel. The distributed intelligent characteristic of the network shall provide for all nodes independently making pertinent system decisions with no need for a central controller. Each node shall be capable of independent operation should loss of network communications occur. In no case shall read-only network annunciation be acceptable as the only networking function.
- H. Voice Communication: The facility shall have an emergency voice alarm communication system. The digitized recorded voice message shall notify occupants that a fire condition has been reported. Emergency manual voice override shall be provided.
- I. Firefighter Phone System: A two-way talk path shall be provided for the fire department's use from the voice command center to the secondary fire alarm attack entrances, elevator lobbies, primary and backup power rooms and the entrance to all enclosed stairways.
- J. Emergency Communication System (ECS): A system capable of reproduction of prerecorded, synthesized, or live messages with voice intelligibility to indicate the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action. The system shall provide alerting in the building[, wide-area notification on the campus and interface with distributed recipient mass notification system].
- K. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.
- L. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.

- M. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.
- N. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 26 05 00.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.
- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 05 00.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.9 DOCUMENT STORAGE CABINET

- A. The cabinet shall have all fire alarm system documents, including record drawings, wiring diagrams, operation manuals, etc. A legend sheet permanently attached to the door shall contain system passwords and inspection logs. The enclosure shall also provide two (2) key ring holders for system keys and a location for a standard size business card with service contact information.
 - 1. The cabinet will have, permanently and securely mounted inside, a digital flash memory device with a minimum of 4 GB of storage capacity and a standard USB B connector for uploading and downloading electronic versions of record documents and system programming information.
- B. The cabinet shall be red in color with an identification label reading "FIRE ALARM DOCUMENTS". Refer to Identification Section 26 05 53. The cabinet shall be lockable.
- C. The final version of the system database program shall be stored within the cabinet.
- D. Locate cabinet in the electrical room.

1.10 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

1.11 ANNUAL INSPECTION/TESTING AND SERVICE CONTRACT

- A. Provide cost to furnish service, inspect, and test all devices of the fire alarm system per the requirement of NFPA for one (1) year, starting one year after the Date of Substantial Completion. Submit written reports of inspection testing per NFPA 72, Chapter 14.
- B. Provide an alternate cost for a complete inspection/testing and service/maintenance contract for the fire alarm system for one (1) year two (2) years, starting one year after the Date of Substantial Completion. Submit sample contract terms and conditions for review with shop drawings.
- C. The Owner may enter into a contract directly with the vendor after shop drawing submittals. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.1 WIRING

- A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with the Electrical Code for power-limited fire alarm signal service.
- B. Fire Alarm Cable:
 - 1. Manufacturers:
 - a. Comtran Corp.
 - b. Helix/HiTemp Cables, Inc.
 - c. Rockbestos-Suprenant Cable Corp.
 - d. West Penn Wire/CDT.
 - e. Radix.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

- A. General:
 - 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
 - 2. The GUI/graphic annunciator shall display audible and visual alarms. The device activated shall be immediately displayed on a CAD floor plan at approximately 1/8" scale. Visual indication shall further indicate the device by utilizing an easily recognized color change of the symbol. The use of flashing symbols is encouraged.

3. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

B. Access Control Override Sequence:

1. The fire alarm shall use addressable output relay(s) to signal the access control panel.
2. Refer to the access control specifications for requirement upon fire alarm signal. [The fire alarm shall initiate an override of delayed egress doors.]

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Devices:

1. General:

- a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
 - b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
 - c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
 - d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall[notify the Architect/Engineer to coordinate a different acceptable location][adjust location of device so that new location meets all requirements in NFPA 72 and all applicable building codes].
2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.
3. Protection of Fire Alarm System:
- a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.
4. In-Duct Analog Smoke Detectors:
- a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.

5. Heat Detector, Linear Wire Type:
 - a. Install detection wire within 20 inches of the underside of building roof, floor, or as recommended by the manufacturer.
 - b. The protected area shall not exceed 4,000 square feet per zone. Provide a separate zone for areas divided by fire/smoke rated walls.
6. Manual Pull Stations:
 - a. Stations shall be located where shown and at the height noted on the drawings.
7. Addressable Relays and Monitor Modules:
 - a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
 - b. All modules shall be mounted in or on a junction box in an accessible location.
 - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
8. SLC Loop Isolation Modules:
 - a. Isolation modules shall be installed to limit the number of addressable devices that are incapacitated by a circuit fault.
 - b. Install all Isolation Modules within the fire alarm control panel, unless otherwise indicated on the drawings. Refer to the fire alarm riser diagram for requirements. Refer to the floor plans for areas served by separate isolation modules.

C. Wiring:

1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
2. Wiring shall be installed in conduit. Refer to Identification Section 26 05 13 for color and identification requirements.
3. Wiring shall be installed in conduit from device to above accessible ceilings. Exposed plenum-rated cable (FPLP) shall be used above accessible ceilings supported every 4 feet or run in cable trays (if applicable) maintaining a minimum of 5-inches clearance from all lighting ballasts. Fire alarm cabling shall not be installed in the same bridge rings or cable trays designated for the cabling of other systems.
4. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 26 05 13 for color and identification requirements.
5. Partial evacuation or relocation of occupants is the standard operating procedure for this facility in the event of an alarm. Therefore, all notification appliance circuits (NAC), including circuits serving NAC extender panels and other network communication circuits, must be installed and protected in accordance with the "circuit survivability" requirements described in NFPA 72. Contractor shall maintain the following:
 - a. NACs serving separate evacuation signaling zones shall be routed separately such that they are no less than 4 feet apart when run horizontally and 1 foot apart when run vertically. They may come simultaneously only within 10 feet of the control panel.
 - b. NACs passing through other evacuation signaling zone(s) shall be installed in conduit and routed through the 2-hour fire-rated chase(s) or enclosure(s) identified on the drawings.

- c. NACs passing through other evacuation signaling zone(s) shall be Electrical Code classified CIC cable (Fire Alarm Circuit Integrity) installed in conduit. Provide CIC cable meeting UL requirements for 2-hour listing.
 - 1) The CIC cable system shall be installed in a conduit system meeting all requirements of its UL-listed installation system (conduit, boxes, connectors, etc.).
 - 6. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
 - 7. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
 - a. Fire alarm temporal audible notification for all audio appliances.
 - b. Synchronization of all visual devices where two or more devices are visible from the same location.
 - c. Ability to silence audible alarm while maintaining visual device operation.
 - d. Emergency communication alert and textual visible appliance notification.
 - 8. Notification Appliance Circuits shall not span floors.
 - 9. Signal line circuits connecting devices shall not span floors or 2-hour smoke compartments.
 - 10. Signal line circuits connecting devices shall be provided with an isolation module at each floor separation or as otherwise shown on the drawings.
 - 11. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- D. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.
- 1. Power Branch Circuit Conductors: In accordance with Section 26 05 53.
 - 2. Signaling Line Circuit: Overall red jacket with black and red conductors.
 - 3. DC Power Supply Circuit: Overall red jacket with violet and brown conductors.
 - 4. Notification Appliance Circuit: Overall red jacket with blue and white conductors.
 - 5. Door Release Circuit: Gray conductors.
 - 6. Central Station Trip Circuit: Orange conductors.
 - 7. Central Station Fire Alarm Loop: Black and white conductors.
- E. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.

- F. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

END OF SECTION