
PROJECT MANUAL

YORK COUNTY GOVERNMENT YORK COUNTY HISTORICAL COURTHOUSE HVAC REPLACEMENT

2 SOUTH CONGRESS STREET, YORK, SC 29745

**DEVITA & ASSOCIATES, INC.
PROJECT NO. 24501-01**

DOCUMENT DATE: JULY 1, 2026
ISSUED FOR PERMIT & BID

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SEALS PAGE**

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**SECTION 00 2113
INSTRUCTIONS TO BIDDERS**

SUMMARY

1.01 YORK COUNTY GOVERNMENT'S FORM "INVITATION FOR BID", WHICH CONTAINS THE INVITATION FOR BIDS AND INSTRUCTIONS TO BIDDERS, IS HEREBY INCORPORATED INTO THE PROCUREMENT AND CONTRACTING REQUIREMENTS BY REFERENCE.

1.02 RELATED DOCUMENTS

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

END OF SECTION 00 2113

**SECTION 00 7200
GENERAL CONDITIONS - YORK CO GOVT**

1. DEFINITIONS

1.1. Whenever used in any of the Contract Documents, the following meanings shall be given to the terms herein defined:

1.1.1. Addendum or Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirements or the Contract Documents.

1.1.2. Agreement - The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

1.1.3. Application for Payment - The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

1.1.4. Bid - The offer or proposal of the bidder on the prescribed Bid Form setting forth the prices for the Work to be performed.

1.1.5. Bidder - One who submits a Bid directly to OWNER, as distinct from sub-bidder, who submits a Bid to a Bidder.

1.1.6. Bidding Documents - The Invitation for Bids, Information to Bidders, the Bid Form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

1.1.7. Bonds - Performance and Indemnity and Payment Bonds and other instruments of security.

1.1.8. Change Order - A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

1.1.9. Contract Documents - Executed Agreement, Addenda (if any), Invitation for Bids, Information to Bidders, Signed Copy of Bid, Bid Guarantee, Statement of Bidder's Qualifications, Performance and Indemnity Bond, Payment Bond, Certification of Insurance, General Conditions, Supplemental Conditions (if any), Special Conditions (if any), Technical Specifications, and Drawings.

1.1.10. Contract Price - The moneys payable by OWNER for completion of the Work in accordance with the Contract Documents.

1.1.11. Contract Times - The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the work so that it is ready for final payment as evidenced by ENGINEER's written records.

1.1.12. CONTRACTOR - The person, firm, or corporation entering into Contract with the OWNER to construct and install the improvements embraced in this Contract.

1.1.13. Defective - An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or had been damaged prior to ENGINEER's recommendation or final payment.

1.1.14. Drawings - The construction drawings which graphically show the scope, extent, and character of the Work to be furnished and performed by the CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents.

1.1.15. ENGINEER - The person, firm or corporation serving the OWNER with Engineering services, his successors, or any other person or persons, employed by said OWNER for the purpose of directing or having charge of the work embraced in this Contract.

- 1.1.16. Laws and Regulations; Laws or Regulations – Any and all applicable laws, rules, regulations, ordinances codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.
- 1.1.17. Liens - Liens, charges, security interests or encumbrances upon project funds, real property or personal property.
- 1.1.18. Local Government – York County, South Carolina, within which the Project Areas are situated.
- 1.1.19. Milestone - A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
- 1.1.20. Notice of Award - The written notice by OWNER to the apparent successful Bidder stating that upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the agreement.
- 1.1.21. Notice to Proceed - A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform, CONTRACTOR's obligations under the Contract Documents.
- 1.1.22. OWNER - The York County Government, which is authorized to undertake this Contract.
- 1.1.23. Partial Utilization - Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.
- 1.1.24. Project - The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.
- 1.1.25. Project Area - The area within which are the specified limits of the improvements to be constructed in whole or in part under this Contract.
- 1.1.26. Project Manual – The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
- 1.1.27. Resident Project Representative – The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.
- 1.1.28. Samples - Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
- 1.1.29. Site – Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by OWNER which are designated for the use of the CONTRACTOR.
- 1.1.30. Shop Drawings - All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.
- 1.1.31. Special Conditions - The part of the Contract Documents that amends or supplements the Technical Specifications.
- 1.1.32. Subcontractor - An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the site.
- 1.1.33. Substantial Completion - The Work (or specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER's definitive certification of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

1.1.34. Successful Bidder - The lowest, qualified, responsible and responsive Bidder to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award.

1.1.35. Supplier – A manufacturer, fabricator, supplier, distributor, material man or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

1.1.36. Supplemental Conditions - The part of the Contract Documents that amends or supplements these General Conditions.

1.1.37. Technical Specifications - The part of the Contract Documents that describes, outlines, and stipulates: the quality of materials, equipment and systems to be furnished; the quality of workmanship required; and the methods to be used in carrying out the construction work to be performed under this Contract.

1.1.38. Underground Facilities - All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, or water.

1.1.39. Unit Price Work - Work to be paid for on the basis of unit prices.

1.1.40. Work - The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing and incorporating materials and equipment into the construction, and furnishing, installing and incorporating all materials and equipment into such construction, all as required by the Contract Documents..

1.2 Other technical terms not specifically defined within the Contract Documents shall have the meanings given in AIA Document "Glossary of Construction Industry Terms," current edition. Technical terms not defined as above and used to describe items of the Work, and which so applied have a well-known technical or trade meaning, shall be deemed to have such recognized meaning.

2. CONTRACTOR'S OBLIGATIONS

2.1. All work shall be done in strict accordance with the Contract Documents. Observations, construction reviews, tests, recommendations or approvals by the ENGINEER or persons other than the CONTRACTOR, shall in no way relieve the CONTRACTOR of his obligations to complete all work in accordance with the Contract Documents. All work shall be done under the direct supervision of the CONTRACTOR. The CONTRACTOR shall be responsible for construction means, methods, techniques, and procedures, and for providing a safe place for the performance of the work by the CONTRACTOR, Subcontractors, suppliers, and their employees and for access, use, work, or occupancy by all authorized persons.

3. LANDS BY CONTRACTOR

3.1. OWNER shall furnish the Site. OWNER shall notify CONTRACTOR of any encumbrances or restrictions not of general application, but specifically related to the use of the Site with which the CONTRACTOR must comply in performing work.

3.2. Any land and access thereto not specifically shown to be furnished by the OWNER that may be required for temporary construction facilities or for storage of materials and equipment shall be provided by the CONTRACTOR with no liability to the OWNER. The CONTRACTOR shall confine his apparatus and storage to such additional areas as he may provide at his expense.

3.3. The CONTRACTOR shall not enter upon private property for any purpose without obtaining permission, and he shall be responsible for the preservation of all public property,

trees, monuments, structures and improvements, along and adjacent to the street and/or right-of-way, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits, and other underground structures, and shall protect carefully from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed.

4. SURVEYS BY CONTRACTOR

4.1. Based upon the Construction Documents and any additional information provided by the OWNER, the CONTRACTOR shall develop and make all detailed surveys necessary for construction, including working points, lines and elevations.

5. PUBLIC UTILITIES

5.1. The elevation and location of all public utilities shown on the Drawings were taken from existing public records. It shall be the duty of the CONTRACTOR to make final and exact determination of the location and extent of all utilities and he will be liable for any expense resulting from damage to them.

6. SUPERINTENDENT

6.1. A qualified superintendent, who is acceptable to the OWNER, shall be maintained on the Work and shall give efficient supervision to the Work until its completion. The superintendent shall have full authority to act in behalf of the CONTRACTOR, and all instruction given to the superintendent shall be considered as given to the CONTRACTOR. It shall be the responsibility of this CONTRACTOR's superintendent to coordinate the Work of all the Subcontractors. The superintendent shall be present on the site at all times required to perform adequate supervision and coordination.

7. SUBCONTRACTORS

7.1. At the time set forth in the Contract Documents or when requested by the OWNER, the CONTRACTOR shall submit in writing for review of the OWNER the names of the Subcontractors proposed for the work. Subcontractors may not be changed except at the request or with the approval of the OWNER. The CONTRACTOR is responsible to the OWNER for the acts and deficiencies of his Subcontractors, and of their direct and indirect employees, to the same extent as he is responsible for the acts and deficiencies of his employees. The Contract Documents shall not be construed as creating any contractual relation between any Subcontractor and the OWNER. The CONTRACTOR shall bind every Subcontractor by the terms of the Contract Documents.

8. ASSIGNMENTS

8.1. The CONTRACTOR shall not assign the whole or any part of this Contract or any moneys due or to become due hereunder without written consent of the OWNER. In case the CONTRACTOR assigns all or any part of any moneys due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any moneys due or to become due to the CONTRACTOR shall be subject to prior claims of all persons, firms, and corporations for services rendered or materials supplied for the performance of the work called for in this Contract.

9. MUTUAL RESPONSIBILITY OF CONTRACTORS

9.1. If through acts of neglect on the part of the CONTRACTOR, any other CONTRACTOR or any Subcontractor shall suffer loss or damage on the work, the CONTRACTOR agrees to settle with such other CONTRACTOR or Subcontractor by agreement or arbitration if such other CONTRACTOR or Subcontractor will so settle. If such other CONTRACTOR or Subcontractor shall assert any claim against the OWNER on account of any damage alleged to have been sustained, the OWNER shall notify the CONTRACTOR, who shall indemnify and save harmless the OWNER against any such claim.

10. ORAL AGREEMENTS

10.1. No oral order, objection, claim or notice by any party to the others shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall be held to be waived or modified by reason of any act whatsoever, other than by a definitely agreed waiver or modification thereof in writing, and no evidence shall be introduced in any proceeding of any other waiver or modification.

11. MATERIALS, SERVICE AND FACILITIES

11.1. It is understood that except as otherwise specifically stated in the Contract Documents, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, gas, light, power, transportation, superintendence, taxes, insurance, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

11.2. Any work necessary to be performed after regular working hours, on Sundays or Legal Holidays, shall be performed without additional expense to the OWNER.

12. MATERIALS AND EQUIPMENT

The materials and equipment installed in the work shall meet the requirements of the Contract Documents and no materials or equipment shall be ordered until reviewed by the ENGINEER. The CONTRACTOR shall furnish all materials and equipment not otherwise specifically indicated or provided by the OWNER. The CONTRACTOR shall guarantee all materials and equipment he provides in accordance with Section 16 of these GENERAL CONDITIONS.

12.1. Substitutions: In order to establish standards of Quality, the ENGINEER has, in the detailed Specifications, referred to certain products by name and catalog number without consideration of possible substitute or "or equal" items. This procedure is not to be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable in design.

12.1.1. Whenever it is indicated in the Drawings or specified in the specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by the CONTRACTOR, the party requesting the substitution shall make written application as described in the Project Manual no later than the date and time specified in the Invitation for Bids. The CONTRACTOR shall furnish the complete list of proposed desired substitutions, together with such engineering and catalog data as the ENGINEER may require. All proposals for substitutions shall be submitted in writing by the General Contractor and not by individual trades or material suppliers. The ENGINEER will review proposed substitutions and make his recommendations in writing within the time specified in the Project Manual.

12.1.2. The CONTRACTOR shall abide by the ENGINEER's recommendation when proposed substitute materials or items of equipment are not recommended for installation and shall furnish the specified material or item of equipment in such case.

12.2. Space Requirements: It shall be the responsibility of the CONTRACTOR to ensure that materials and equipment to be furnished fit the space available. He shall make necessary field

measurements to ascertain space requirements, including those for connections, and shall order such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Contract Documents.

12.3. Arrangement: Where equipment requiring different arrangement of connections from those shown is approved, it shall be the responsibility of the CONTRACTOR to install the equipment to operate properly, and in harmony with the intent of the work required by such arrangement.

12.4. Unacceptable Materials and Equipment: Materials and equipment which do not conform to the requirements of the Contract Documents, or are not equal to samples reviewed by the ENGINEER, or are in any way unsatisfactory or unsuited to the purpose for which they are intended, shall not be furnished nor installed.

12.5. Storage: Materials and equipment shall be so stored as to ensure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground and/or they shall be placed under cover. Stored materials and equipment shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without the written permission of the property owner or leasee. Materials, equipment, construction machinery, fuel, and oils shall not be stored or parked within the drip-line of any trees in or adjacent to the project site or additional off-site easements and right-of-ways.

12.6. Manufacturer's Directions: Manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer.

13. INSPECTION AND TESTING OF MATERIALS

13.1. Unless otherwise specifically provided for in the specifications, the inspection and testing of material and finished articles to be incorporated in the work at the site shall be made by bureaus, laboratories, or agencies approved by the OWNER. The cost of such inspection and testing shall be paid by the CONTRACTOR. The CONTRACTOR shall furnish evidence satisfactory to the OWNER that the material and finished articles have passed the required tests prior to the incorporation of such materials and finished articles in the work. The CONTRACTOR shall promptly segregate and remove rejected material and finished articles from the site of the work.

14. SAMPLES

14.1. All samples called for in the Specifications or required by the ENGINEER shall be furnished by the CONTRACTOR and shall be submitted to the ENGINEER for his review. Samples shall be furnished so as not to delay fabrication, allowing the ENGINEER reasonable time for the consideration of the samples submitted.

14.1.1. Samples for Tests: CONTRACTOR shall furnish such samples of material as may be required for examination and test. All samples of materials for tests shall be taken according to standard methods or as provided in the Contract Documents.

14.1.2. CONTRACTOR's Guaranty: All samples shall be submitted by the CONTRACTOR with a covering letter indicating that such samples are recommended by the CONTRACTOR for the service intended and that the CONTRACTOR's Guaranty will fully apply.

14.1.3. All materials, equipment and workmanship shall be in accordance with samples guaranteed by the CONTRACTOR and reviewed by the ENGINEER.

15. SHOP DRAWINGS

15.1. The CONTRACTOR shall provide shop drawings, setting schedules and such other drawings as may be necessary for the prosecution of the work in the shop and in the field as

required by the Drawings, Specifications or the ENGINEER's instructions. Deviations from the Drawings and Specifications shall be called to the attention of the ENGINEER at the time of the first submission of shop drawings and other drawings for consideration. The ENGINEER's review of any drawings shall not release the CONTRACTOR from responsibility for such deviations. Shop drawings shall be submitted according to a schedule prepared jointly by the CONTRACTOR and the ENGINEER.

15.1.1. CONTRACTOR's Certification: When submitted for the ENGINEER's review, shop drawings shall bear the CONTRACTOR's certification that he has reviewed, checked and approved the shop drawings, that they are in harmony with the requirements of the Project and with the provisions of the Contract Documents, and that he has verified all field measurements and construction criteria, materials, catalog numbers and similar data. CONTRACTOR shall also certify that the work represented by the shop drawings is recommended by the CONTRACTOR and the CONTRACTOR's Guaranty will fully apply.

16. GUARANTY

16.1. The CONTRACTOR shall guarantee all materials and equipment furnished and work performed for a period of one year from the date of Substantial Completion.

16.1.1. The Performance and Indemnity Bond shall remain in full force and effect during the guaranty period.

16.1.2. Correction of faulty work after final payment shall be as provided in Paragraph 41.

17. INSURANCE

17.1. The CONTRACTOR shall not commence any work until he obtains, at his own expense, all required insurance. Such insurance must have the approval of the OWNER as to the limit, form, and amount. The CONTRACTOR will not permit any Subcontractor to commence work on this project until such Subcontractor has complied with the same insurance requirements.

17.1.1. Types: The types of insurance the CONTRACTOR is required to obtain and maintain for the full period of the Contract will be: Workmen's Compensation Insurance, Automobile and Comprehensive General Liability Insurance as detailed in the following portions of this specification.

17.1.2. Evidence: As evidence of specified insurance coverage, the OWNER may, in lieu of actual policies, accept certificates issued by the insurance carrier showing such policies in force for the specified period. Each policy or certificate will bear an endorsement or statement waiving right of cancellation or reduction in coverage within ten days' notice in writing to be delivered by registered mail to the OWNER. Should any policy be cancelled before final payment by the OWNER to the CONTRACTOR and the CONTRACTOR fails immediately to procure other insurance as specified, the OWNER reserves the right to procure such insurance and to deduct the cost thereof from any sum due the CONTRACTOR under this Contract.

17.1.3. Adequacy of Performance: Any insurance bearing on adequacy of performance shall be maintained after completion of the project for the full guaranty period. Should such insurance be cancelled before the end of the guaranty period and the CONTRACTOR fails immediately to procure other insurance as specified, the OWNER reserves the right to procure such insurance and to charge the cost thereof to the CONTRACTOR.

17.1.4. Payment of Damages: Nothing contained in these insurance requirements is to be construed as limiting the extent of the CONTRACTOR's responsibility for payment of damages resulting from his operations under this Contract.

18. WORKMEN'S COMPENSATION INSURANCE

18.1. Before the Agreement between the OWNER and the CONTRACTOR is entered into, the CONTRACTOR shall submit written evidence that he and all Subcontractors have obtained, for

the period of the Contract, full Workman's Compensation Insurance coverage for all persons whom they employ or may employ in carrying out the work under this Contract. This insurance shall be in strict accordance with the requirements and statutory limits of the most current and applicable South Carolina Workman's Compensation Insurance Laws.

19. COMPREHENSIVE GENERAL LIABILITY AND AUTOMOBILE INSURANCE

19.1. Before commencement of the work, the CONTRACTOR shall submit written evidence that he and all his Subcontractors have obtained for the period of the Contract, full Comprehensive General Liability Insurance and automobile coverage. This coverage shall provide for both bodily injury and property damage.

19.1.1. Comprehensive General Liability Insurance shall include coverage for bodily injury, sickness or disease, death, or property damage arising directly or indirectly out of or in connection with the performance of work under this Contract, and shall provide for a combined single limit of not less than one million (\$1,000,000) dollars for all damages arising out of bodily injury, sickness or disease, death, or property damage for each occurrence.

19.1.2. Automobile insurance shall include coverage for bodily injury and property damage arising directly or indirectly out of or in connection with the performance of work under this Contract, and shall provide for a combined single limit of not less than one million (\$1,000,000) dollars for all damages arising out of bodily injury or property damage for each occurrence.

19.1.3. Indemnity: Included in such insurance will be contractual coverage sufficiently broad to insure the provisions of Paragraph 20.

20. INDEMNITY

20.1. The CONTRACTOR shall hold harmless, indemnify and defend the OWNER, its successors and assigns, the ENGINEER, their consultants, and each of their officers and employees and agents, from any and all liability claims, losses or damage arising or alleged to arise from the performance of the work described herein, but not including the sole negligence of the OWNER or the ENGINEER.

21. PATENTS AND ROYALTIES

21.1. If any design, device, material or process covered by letters, patent or copyright is used by the CONTRACTOR, he shall provide for such use by legal agreement with the OWNER of the patent or a duly authorized licensee of such OWNER, and shall save harmless the OWNER and the ENGINEER, from any and all loss or expense on account thereof, including its use by the OWNER.

22. PERMITS

22.1. All permits and licenses necessary for the prosecution of the work shall be secured and paid for by the CONTRACTOR. This shall include all Business Licenses required by the Local Government.

23. LAWS TO BE OBSERVED

23.1. The CONTRACTOR shall give all notices and comply with all Federal, State and local laws, ordinances and regulations in any manner affecting the conduct of the work, and all such orders and decrees as exist, or may be enacted by bodies or tribunals having any jurisdiction or authority over the work, and shall indemnify and save harmless the OWNER its successors and assigns, the ENGINEER, their consultants, and each of their officers and employees and

agents against any claim or liability arising from, or based on, the violation of any such law, ordinance, regulation, order or decree, whether by himself or his employees.

24. WARNING SIGNS AND BARRICADES

24.1. The CONTRACTOR shall provide adequate signs, barricades, and watchmen and take all necessary precautions for the protection of the work and the safety of the public.

25. PUBLIC CONVENIENCE

25.1. The CONTRACTOR shall at all times so conduct his work as to ensure the least possible obstruction to traffic and inconvenience to the general public and the residents in the vicinity of the work, and to ensure the protection of persons and property. No road or street shall be closed to the public except with permission of the proper authorities. Fire hydrants on or adjacent to the work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to ensure the use of sidewalks and the proper functioning of all gutters, sewer inlets, drainage ditches, and irrigation ditches, which shall not be obstructed.

26. SAFETY

26.1. The CONTRACTOR shall be solely and completely responsible for the conditions of the job site, including safety of all persons and property affected directly or indirectly by his operation during the performance of the work. This requirement will not be limited to normal working hours but will apply continuously 24 hours per day until written acceptance of the work by the OWNER and shall not be limited to normal working hours.

26.2. The ENGINEER's construction reviews of the CONTRACTOR's performance is not intended to include review of the adequacy of the CONTRACTOR's safety measures in, on, or near the construction site.

27. NOTICE TO PROCEED

27.1. Following the execution of the Contract by the OWNER and the CONTRACTOR, written Notice to Proceed with the work shall be given by the OWNER to the CONTRACTOR. The CONTRACTOR shall begin and shall prosecute the work regularly and uninterruptedly thereafter (except as provided for herein) with such force as to secure the completion of the work within the Contract Time.

28. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

28.1. It is hereby understood and mutually agreed, by and between the CONTRACTOR and the OWNER, that the date of beginning and the time for completion as specified in the Contract of the work to be done hereunder are ESSENTIAL CONDITIONS of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on a date to be specified in the Notice to Proceed.

28.2. The CONTRACTOR agrees that said work shall proceed regularly, diligently, and uninterruptedly at such rate of progress as will ensure full completion thereof within the time specified. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the time for the completion of the work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

28.3. If said CONTRACTOR shall neglect, fail, or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the OWNER, then the CONTRACTOR does hereby agree, as a part consideration for the awarding of this Contract, to

pay to the OWNER the amount specified in the Contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the CONTRACTOR shall be in default after the time stipulated in the Contract for completing the work.

28.4. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would in such event sustain, and said amount is agreed to be the amount of damages which the OWNER would sustain and said amount shall be retained from time to time by the OWNER from current periodical estimates.

28.5. It is further agreed that time is of the essence of each and every portion of this Contract and of the Specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract. PROVIDED, that the CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following:

28.5.1. Any preference, priority or allocation order duly issued by the Federal or State Government.

28.5.2. Unforeseeable cause beyond the control and without the fault or negligence of the CONTRACTOR, including, but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, flood, epidemics, quarantine restrictions, strikes, freight embargoes and unusually severe weather; and

28.5.3. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsection 28.5.1. and 28.5.2. of this article:

PROVIDED, FURTHER, that the CONTRACTOR shall, within 10 days from the beginning of such delay, unless the OWNER shall grant a further period of time prior to the date of final settlement of the contract, notify the OWNER, in writing, of the causes of the delay, who shall ascertain the facts and extent of the delay and notify the CONTRACTOR within a reasonable time of its decision in the matter, and grant such extension of time as the OWNER shall deem equitable and just.

29. CONSTRUCTION SCHEDULE AND PERIODIC ESTIMATES

29.1. Immediately after execution and delivery of the contract, and before the first partial payment is made, the CONTRACTOR shall deliver to the OWNER an estimated construction progress schedule in a form satisfactory to the OWNER, showing the proposed dates of commencement and completion of each of the various subdivisions of work required under the Contract Documents.

30. EXTENSION OF CONTRACT TIME

30.1. A delay beyond the CONTRACTOR's control occasioned by an Act of God, by act or omission on the part of the OWNER or by strikes, lockouts, fire, etc., may entitle the CONTRACTOR to any extension of time in which to complete the work as agreed by the OWNER, provided, however, that the CONTRACTOR shall immediately give written notice to the OWNER of the cause of such delay.

30.2. Act of God shall mean an earthquake, flood, cyclone, or other cataclysmic phenomenon. Storms of normal intensity for the locality shall not be construed as an Act of God and no reparation shall be made to the CONTRACTOR for damages to the work resulting there from.

31. EXTRA WORK

31.1. New and unforeseen items of work found to be necessary, and which cannot be covered by any item or combination of items for which there is a Contract price, shall be classed as Extra Work. It shall be the responsibility of the CONTRACTOR to identify necessary work items classed as Extra Work and for which no previous contract price has been arranged and advise the ENGINEER and the OWNER of the need for the aforesaid necessary Extra Work. The CONTRACTOR shall do such Extra Work and furnish such materials as may be required for the proper completion or construction of the whole work contemplated, upon written order from the OWNER as approved by the ENGINEER. In the absence of such written order, no claim for Extra Work shall be considered.

31.2. Extra Work shall be performed in accordance with these Contract Documents where applicable and work not covered by such shall be done in accordance with the best construction practice and in a workmanlike manner.

31.3. Extra Work required in an emergency to protect life and property shall be performed by the CONTRACTOR as required.

32. CLEANING UP

32.1. The CONTRACTOR shall at all times, keep the premises clean and shall remove from the OWNER's property, and from all public and private property, temporary structures, rubbish, waste materials resulting from his operation or caused by his employees, and all surplus materials, leaving the site smooth, clean and true to line and grade and in the same condition as existed prior to the work performed by the CONTRACTOR or his Subcontractors and as approved by the OWNER. Failure to maintain a clean project site or to complete clean-up of the project site at the completion of the work shall be cause for the OWNER to perform the necessary clean-up and the costs thereof shall be charged to the CONTRACTOR.

33. REQUEST FOR PAYMENT

33.1. The CONTRACTOR may submit to the OWNER periodically, but not more than once each month, a Request for Payment for work done and materials delivered to and stored on the site. The CONTRACTOR shall furnish the OWNER all reasonable information required for obtaining the necessary data relative to the progress and execution of the work. Payment for materials stored on the site will be conditioned upon evidence submitted to establish the OWNER's title to such materials. Each Request for Payment shall be computed on the basis of work completed on all items listed in the Detailed Breakdown of Contract (or on unit prices, as the case may be), less 10 percent to be retained until final completion and acceptance of the work and less previous payments.

34. ENGINEER'S ACTION ON REQUEST FOR PAYMENT

34.1. All CONTRACTOR's Requests for Payment shall be referred to the ENGINEER for his review and, within a reasonable period, the ENGINEER shall:

34.1.1. Recommend payment by the OWNER of the Request for Payment as submitted.

34.1.2. Recommend payment by the OWNER of such other amount as the ENGINEER shall consider as due the CONTRACTOR, informing the OWNER and the CONTRACTOR in writing of his reasons for recommending the amended amount.

34.1.3. Recommend to the OWNER that payment of the Request for Payment be withheld, informing the CONTRACTOR and the OWNER in writing of his reasons, for so recommending.

35. OWNER'S ACTION ON REQUEST FOR PAYMENT

35.1. Within thirty days after receipt of a Request for Payment from the CONTRACTOR, the OWNER shall:

- 35.1.1. Pay the Request for Payment as recommended by the ENGINEER.
- 35.1.2. Pay such other amount, in accordance with Paragraph 36, as he shall decide is due the CONTRACTOR, informing the CONTRACTOR and the ENGINEER in writing of this reasons for paying the amended amount.
- 35.1.3. Withhold payment in accordance with Paragraph 36, informing the CONTRACTOR and the ENGINEER of his reasons for withholding payment.

36. OWNER'S RIGHT TO WITHHOLD PAYMENT OF A REQUEST FOR PAYMENT

- 36.1. The OWNER may withhold payment, in whole or in part, of a Request for Payment to the extent necessary to protect himself from loss on account of any of the following:
 - 36.1.1. Defective work.
 - 36.1.2. Evidence indicating the probable filing of claims by other parties against the CONTRACTOR that may adversely affect the OWNER.
 - 36.1.3. Failure of the CONTRACTOR to make payments due to Subcontractors, material suppliers, or employees.
 - 36.1.4. Damage to another CONTRACTOR.

37. PAYMENT FOR EXTRA WORK

- 37.1. Written notice of claims for payment for Extra Work shall be given by the CONTRACTOR within ten days after receipt of instructions from the OWNER to proceed with the Extra Work and also before any work is commenced, except in emergency endangering life or property. No claim shall be valid unless so made. In all cases, the CONTRACTOR's itemized estimate sheets showing all labor and material shall be submitted to the OWNER. The OWNER's order for Extra Work shall specify any extension of the Contract Time and one of the following methods of payment:
 - 37.1.1. Unit prices or combination of unit prices which formed the basis of the original Contract.
 - 37.1.2. Actual cost plus overhead and profit. The combined overhead and profit included in the total cost to the OWNER for Extra Work shall be based on the following schedule:
 - 37.1.2.1. For the CONTRACTOR, for Extra Work performed by the CONTRACTOR's own forces, not to exceed fifteen (15%) percent of the CONTRACTOR's actual costs.
 - 37.1.2.2. For the CONTRACTOR, for Extra Work performed by the CONTRACTOR's Subcontractors, not to exceed ten (10%) percent of each Subcontractor's actual costs (not including the Subcontractor's overhead and profit).
 - 37.1.2.3. For each Subcontractor involved, for Extra Work performed by the Subcontractor's own forces, not to exceed fifteen (15%) percent of the Subcontractor's actual costs.
 - 37.1.3. The percentages cited above shall be considered to include all indirect costs including but not limited to field and office managers, supervisors and assistants, incidental job burdens, small tools, and general overhead allowances.
 - 37.1.4. Cost to which overhead and profit is to be applied shall be limited to the following:
 - 37.1.4.1. Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the ENGINEER.
 - 37.1.4.2. Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed.
 - 37.1.4.3. Rental costs of machinery and equipment, whether rented from the CONTRACTOR or others.
 - 37.1.4.3.1. Rental costs shall be limited to Associated General Contractors of America standard rental rates on each piece of equipment having a value in excess of \$50.00. Equipment and tools of lesser value are considered "small tools" and, as such, are considered to be part of overhead.

37.1.4.4. Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the Extra Work.

38. ACCEPTANCE AND FINAL PAYMENT

38.1. When the CONTRACTOR has completed the work in accordance with the terms of the Contract Documents, he shall certify completion of the work to the OWNER and submit a final Request for Payment, which shall be the Contract Amount plus all approved additions, less all approved deductions and less previous payments made. The CONTRACTOR shall furnish evidence that he has fully paid all debts for labor, materials, and equipment incurred in connection with the work, and upon acceptance by the OWNER, the OWNER will release the CONTRACTOR except as to the conditions of the Performance and Indemnity Bond and the Labor and Material Payment Bond, any legal rights of the OWNER, required guaranties, and Correction of Faulty Work after Final Payment, and will pay the CONTRACTOR's final Request of Payment. The CONTRACTOR shall allow sufficient time between the time of completion of the work and approval of the final Request for Payment for the ENGINEER to assemble and check the necessary data.

38.1.1. Release of Liens: The CONTRACTOR shall deliver to the OWNER a complete release of all liens arising out of this Contract before the retained percentage or before the final Request for Payment is paid. If any liens remains unsatisfied after all payments are made, the CONTRACTOR shall refund to the OWNER such amounts as the OWNER may have been compelled to pay in discharging such liens including all costs and a reasonable attorney's fees.

39. OWNER'S RIGHT TO TERMINATE AGREEMENT

39.1. The OWNER shall have the right to terminate his agreement with the CONTRACTOR after giving ten days' written notice of termination to the CONTRACTOR in the event of any default by the CONTRACTOR.

39.1.1 Default by CONTRACTOR: It shall be considered a default by the CONTRACTOR whenever he shall:

39.1.1.1. Declare bankruptcy, become insolvent, or assign his assets for the benefit of his creditors.

39.1.1.2. Disregard or violate provisions of the Contract Documents or fail to prosecute the work according to the agreed Schedule of Completion, including extensions thereof.

39.1.1.3. Fail to provide a qualified superintendent, competent workmen or Subcontractors, or proper materials, or fail to make prompt payment thereof.

39.1.2. Completion by the OWNER: In the event of termination of the Agreement by the OWNER because of default by the CONTRACTOR, the OWNER may take possession of the work and of all materials and equipment thereon and may finish the work by whatever method and means he may select.

40. TERMINATION OF CONTRACTOR'S RESPONSIBILITY

40.1. The Contract will be considered complete when all work has been finished and the project accepted in writing by the OWNER. The CONTRACTOR's responsibility shall then cease, except as set forth in his Performance and Indemnity Bond, as provided in Paragraph 16, Guaranty, and as provided in Paragraph 41, Correction of Faulty Work After Final Payment.

41. CORRECTION OF FAULTY WORK AFTER FINAL PAYMENT

41.1. The making of the final payment by the OWNER to the CONTRACTOR shall not relieve the CONTRACTOR of responsibility for faulty materials or workmanship. The CONTRACTOR shall promptly replace any such defects, as determined by the ENGINEER, discovered within one year from the date of Substantial Completion of the work.

42. INSPECTION

42.1. The authorized representatives of the ENGINEER and OWNER shall be permitted to inspect all materials, workmanship, and other relevant project records and data. Materials and workmanship will be subject to the approval of the OWNER and/or his representative.

43. CORRECTION OF WORK

43.1. All work, all materials, whether incorporated in the work or not, all processes of manufacture, and all methods of construction shall be, at all times and places, subject to the inspection of the ENGINEER who shall be the final judge of the quality and suitability of the work, materials, process of manufacturer, and methods of construction for the purposes for which they are used. Should they fail to meet his approval, they shall be forthwith reconstructed, made good, replaced and/or corrected, as the case may be, by the CONTRACTOR at his own expense. Rejected material shall immediately be removed from the site. If, in the opinion of the ENGINEER, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the Contract hereunder shall be reduced by such amount as in the judgment of the ENGINEER shall be equitable.

44. EXISTING CONDITIONS FOUND DIFFERENT

44.1. Should the CONTRACTOR encounter existing conditions at the site materially differing from those shown on the Plans or indicated in the Specifications, he shall immediately give notice to the ENGINEER of such conditions before they are disturbed. The ENGINEER will thereupon promptly investigate the conditions, and if he finds and so determines that they materially differ from those shown on the Plans or indicated in the Specifications, he will at once make such changes in the Plans and/or Specifications, as he may find necessary. Any increase or decrease of cost resulting from such changes are to be adjusted in the manner provided in Paragraph 37 of the General Conditions.

45. CONTRACT SECURITY

45.1. The CONTRACTOR shall furnish a Performance Indemnity Bond and Payment Bond (forms attached) in an amount at least equal to 100% of the contract prices as security for the faithful performance of this Contract, as the security for the payment of all persons performing labor on the project under this Contract, and furnishing materials in connection with this Contract. The Performance and Indemnity Bond and the Payment Bond may be in one or in separate instruments in accordance with local law. Before final acceptance, each bond must be approved by the OWNER.

46. DISPUTE RESOLUTION

46.1 OWNER and CONTRACTOR agree to negotiate all disputes between them in good faith prior to exercising their rights under law.

46.2 Any claim, dispute or other matter in question arising from or related to this Agreement or the performance or breach thereof, which cannot be resolved through direct discussions between parties shall be subject to mediation as a condition precedent to the institution of legal or equitable proceedings by either party, and only after both parties have completed the mediation process.

46.3 Through mediation, CONTRACTOR and OWNER shall endeavor to resolve claims, disputes, or other matters in question between them by mediation in an informal process in which a third-party mediator facilitates discussion between the parties. The parties may designate a mediator mutually agreeable to both CONTRACTOR and OWNER to conduct the

mediation. If the parties are unable to agree upon a mediator, mediation shall be conducted in accordance with the mediation provision of the South Carolina Circuit Court Alternative Dispute Resolution Rules. The mediation shall be conducted in York County, South Carolina. A request for mediation shall be filed in writing with the other party to this Agreement, and legal or equitable proceedings shall be stayed pending mediation for a period of sixty (60) days from the date of the request for mediation is filed, unless stayed for a longer period of time by agreement of the parties or court order. The cost of a third-party mediator will be shared equally by the parties.

46.4 If the parties reach an agreement during the mediation process, they shall reduce the agreement to writing and sign it with their attorneys, if any. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

46.5 In any action or proceedings to enforce or interpret any provision of this Agreement, or where any provision herein is validity asserted as a defense, each Party shall bear its own attorney fees, costs, and expenses.

END OF SECTION 00 7200

**SECTION 01 1000
SUMMARY**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 PROJECT

- A. Project Name: York County Historical Courthouse HVAC Replacement.
- B. Owner's Name: York County Government.
- C. Engineer/Architect's Name: DeVita & Associates, Inc.
- D. The Project consists of renovation of the existing HVAC systems, with associated electrical, fire alarm, architectural, structural, and site work. Includes construction of new boiler room, ceiling removal/replacement, and remote chiller yard.

1.03 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in the Owner's bidding documents.

1.04 OWNER OCCUPANCY

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
 - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Existing building spaces may not be used for storage.
- D. Time Restrictions:
 - 1. On-Site Work Hours are generally from approximately 7:00 AM to 5:00 PM.
 - 2. With Owner approval, Contractor's management personnel may be on-site during off-hours and Contractor may receive deliveries during off-hours but should not disrupt or interfere with local traffic and Owner operations. Notify Owner at least 72 hours in advance; Owner staff must be on-site during off-hours.
 - 3. The Contractor can establish alternate work hours as deemed necessary to meet project completion dates, provided hours are approved by the Owner, and coordinated so Owner staff can be on-site.
 - a. Holidays: Not allowed
 - b. Weekend Hours: Work may occur at any time, as pre-approved by Owner.
 - c. Hours for Public Utility Shutdowns: As pre-approved by Owner with at least five (5) days of advance notice.
 - d. Special Events: The Owner will provide dates and times of special events that will restrict construction operations.
 - 4. Limit work in all existing parking lots to outside normal business hours. Allow daily access to the public to the greatest extent possible.
- E. Utility Outages and Shutdown:

1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
2. Limit shutdown of utility services to 2 hours at a time, arranged at least 24 hours in advance with Owner.
3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Owner.

END OF SECTION 01 1000

**SECTION 01 2000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Section 00 7200 - General Conditions: Additional requirements for progress payments, final payment, changes in the Work.
- C. Section 01 2100 - Allowances: Payment procedures relating to allowances.
- D. Section 01 7800 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Engineer/Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in electronic format within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- H. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Engineer/Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit one electronic and no hard-copies of each Application for Payment.
- I. Include the following with the application:

1. Transmittal letter as specified for submittals in Section 01 3000.
 2. Affidavits attesting to off-site stored products.
- J. When Engineer/Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 MODIFICATION PROCEDURES

- A. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
- B. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Engineer/Architect will issue instructions directly to Contractor.
- C. For other required changes, Contractor shall issue a Proposed Change Order (PCO), Change Order Request (COR), or similar document, to be authorized by the Engineer/Architect and Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 2. Promptly execute the change.
 3. PCO/COR Log: Prepare and maintain a tabular log of PCOs for the duration of the project.
 - a. Indicate current status of every PCO. Update log promptly and on a regular basis.
 - b. Note dates of when each request is made, and when a response is received.
 - c. Note origination source of each PCO (e.g., RFI, CCD, Owner proposal request, etc.)
 - d. Note proposed funding source for each PCO.
- D. For changes for which advance pricing is desired, Engineer/Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days or time specified in proposal request.
- E. Contractor may propose a change by submitting a request for change to Engineer/Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.
- F. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- G. Substantiation of Costs: Provide full information required for evaluation.
 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

- H. Execution of Change Orders: Engineer/Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2000

**SECTION 01 2100
ALLOWANCES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contingency allowance.
- B. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

- A. Section 01 2000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
- B. Funds will be drawn from the Contingency Allowance only by Change Order.
- C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.04 ALLOWANCES SCHEDULE

- A. Allowance No. 1: Contingency Allowance: Include ten percent (10%) of the Contract Sum for use upon Owner's written instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2100

**SECTION 01 2500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 01 2100 - Allowances, for cash and quantity allowances affecting this section.
- C. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- D. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 6. Agrees to reimburse Owner and Engineer/Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 - 1. Note explicitly any non-compliant characteristics.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
- E. Limit each request to a single proposed substitution item.

1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
 2. Following the receipt of bids, NO FURTHER REQUESTS for substitution of products or materials will be considered for the duration of the Work, except for limited Substitutions for Cause.
- B. Submittal Form (before award of contract):
 1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Engineer/Architect, in order to stay on approved project schedule.
- C. Substitutions for Convenience: Not allowed.
- D. Substitutions will not be considered under one or more of the following circumstances:
 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.

3.04 RESOLUTION

- A. Engineer/Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Engineer/Architect will notify Contractor in writing of decision to accept or reject request.

3.05 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

3.07 ATTACHMENTS

- A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.

END OF SECTION

SUBSTITUTION REQUEST FORM

SECTION, LINE, PARAGRAPH	SPECIFIED ITEM	PROPOSED SUBSTITUTION

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

PROPOSED SUBSTITUTION

THE UNDERSIGNED CERTIFIES THAT THE FOLLOWING PARAGRAPHS, UNLESS MODIFIED BY ATTACHMENTS, ARE CORRECT:

- A. The function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.
- B. The proposed substitution does not affect dimensions shown on drawings.
- C. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction cost caused by the request substitution.
- D. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
- E. Maintenance and service parts will be locally available for the proposed substitution.

Submitted by: _____

Signature/Title: _____

Date: _____

Address: _____

Telephone: _____

Cost Credits: _____

Attachments: _____

NO SUBSTITUTION REQUEST IS APPROVED UNLESS IT IS INCLUDED IN THE CONTRACT DOCUMENTS BY ADDENDUM OR CHANGE ORDER.

END OF SECTION 01 2500

**SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Web-based project software service.
- C. Electronic document submittal service.
- D. Preconstruction meeting.
- E. Site mobilization meeting.
- F. Progress meetings.
- G. Construction progress schedule.
- H. Contractor's daily reports.
- I. Progress photographs.
- J. Coordination drawings.
- K. Submittals for review, information, and project closeout.
- L. Number of copies of submittals.
- M. Requests for Information (RFI) procedures.
- N. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 00 7200 - General Conditions:
- B. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- C. Section 01 6000 - Product Requirements: General product requirements.
- D. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- E. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 REFERENCE STANDARDS

- A. AIA G716 - Request for Information; 2004.
- B. AIA G810 - Transmittal Letter; 2001.

1.04 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Engineer/Architect:
 - 1. Requests for Interpretation (RFI).
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.

11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WEB-BASED PROJECT SOFTWARE SERVICE

- A. Web-Based Project Software Service: Contractor may elect to provide, administer, and use web-based project software to host and manage project communication and documentation.
 1. Include, at minimum, the following features:
 - a. Project directory, including Owner, Contractor, subcontractors, Engineer/Architect, Engineer/Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
 - b. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
 - c. Workflow planning, allowing customization of workflow for each project entity.
 - d. Creation, logging, tracking, and notification for project communications.
 - e. Tracking of project communication statuses in real time, including timestamped response log.
 - f. Procedures for viewing PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creation and distribution of meeting minutes.
 - j. Document management for drawings, specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility.
 - m. Creation of data analytics reports.
 - n. Creation and export of editable logs for software functions. Provide Owner, Engineer/Architect, and Engineer/Architect's consultants with rights and ability to download logs when requested.
 2. Cost: Pay cost of service. Include the cost of the service in the contract sum.
 3. Provide user licenses for use by Owner, Engineer/Architect, Engineer/Architect's consultants, and other entities involved in the project.
 4. Comply with the software service's current published licensing agreements.
 5. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
 - a. Representatives of Owner are scheduled and included in this training.
 6. Project Closeout: Engineer/Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.
 7. Web-Based Project Software Services: Use one of the following:
 - a. Procore.
 - b. Autodesk Forma
 - c. Newforma, Inc; Newforma Project Center (NPC) with Newforma Info Exchange (NIX): www.newforma.com/#sle.
 8. RedTeam software service is not allowed.

3.02 ELECTRONIC DOCUMENT SUBMITTAL REQUIREMENTS

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF or MS Excel) format, as appropriate to the document.
 1. In addition to submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction

- punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in allowable format.
 - 3. Contractor, subcontractors, and suppliers, need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com).
 - 4. Paper document transmittals will not be reviewed.
 - 5. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Multiple documents that constitute a single submittal of any kind shall be bound in a single file with appropriate cover sheet. Separate individual files for the same submittal are not acceptable.

3.03 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
- 1. Owner.
 - 2. Engineer/Architect.
 - 3. Contractor.
- C. Agenda:
- 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Submission of initial Submittal schedule.
 - 6. Designation of personnel representing the parties to Contract and Engineer/Architect.
 - 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 8. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer/Architect, Owner, participants, and those affected by decisions made.

3.04 SITE MOBILIZATION MEETING

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
- 1. Contractor.
 - 2. Owner.
 - 3. Contractor's superintendent.
 - 4. Major subcontractors.
- C. Agenda:
- 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Application for payment procedures.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Requirements for start-up of equipment.

12. Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer/Architect, Owner, participants, and those affected by decisions made.

3.05 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum biweekly intervals.
 1. Meetings may be conducted via electronic virtual meeting platform (e.g., Microsoft Teams, Zoom, Webex) as appropriate.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
 1. Contractor.
 2. Owner.
 3. Engineer/Architect.
 4. Contractor's superintendent.
 5. Major subcontractors.
- D. Agenda:
 1. Review minutes of previous meetings.
 2. Review of work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of RFIs log and status of responses.
 7. Review of off-site fabrication and delivery schedules.
 8. Maintenance of progress schedule.
 9. Corrective measures to regain projected schedules.
 10. Planned progress during succeeding work period.
 11. Coordination of projected progress.
 12. Maintenance of quality and work standards.
 13. Effect of proposed changes on progress schedule and coordination.
 14. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer/Architect, Owner, participants, and those affected by decisions made.

3.06 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 1. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.07 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. Transmit electronically a copy to Owner and Engineer/Architect at monthly intervals.
 1. Submit in format acceptable to Owner.

- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 - 1. Date.
 - 2. High and low temperatures, and general weather conditions.
 - 3. Safety, environmental, or industrial relations incidents.
 - 4. Meetings and significant decisions.
 - 5. Unusual events (submit a separate special report).
 - 6. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
 - 7. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
 - 8. Change Orders received and implemented.
 - 9. Testing and/or inspections performed.
 - 10. Signature of Contractor's authorized representative.

3.08 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- C. Photography Type: Digital; electronic files.
- D. Provide photographs of site and construction throughout progress of work acceptable to Engineer/Architect.
- E. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Completion of site clearing.
 - 2. Excavations in progress.
 - 3. Structural framing in progress and upon completion.
 - 4. Final completion.
- F. Take photographs as evidence of existing project conditions as follows:
 - 1. Interior views: All affected rooms and spaces.
 - 2. Exterior views: Building facade and all affected areas of the site.
- G. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Consult with Engineer/Architect for instructions on views required.
 - 3. Provide factual presentation.
 - 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
 - 1. Delivery Medium: Via email.
 - 2. File Naming: Include project identification, date and time of view, and view identification.
 - 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 - 4. Hard Copy: Printed hardcopy (grayscale) of PDF file.

3.09 COORDINATION DRAWINGS

- A. Provide information required by project team for preparation of coordination drawings.
- B. Review drawings prior to submission to Engineer/Architect.

3.10 REQUESTS FOR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Engineer/Architect.
 - a. Use AIA G716 - Request for Information as minimum required RFI format.
 - 3. Combine RFI and its attachments into a single electronic file.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
 - 3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 - 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Engineer/Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. Owner's, Engineer/Architect's, and Contractor's names.
 - 3. Discrete and consecutive RFI number, and descriptive subject/title.
 - 4. Issue date, and requested reply date.
 - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 - 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract

Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
 - 3. Highlight items requiring priority or expedited response.
 - 4. Highlight items for which a timely response has not been received to date.
 - 5. Identify and include improper or frivolous RFIs.
- G. Review Time: Engineer/Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
 - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 - 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 - 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 - 4. Notify Engineer/Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.11 SUBMITTAL SCHEDULE

- A. Submit to Engineer/Architect for review a schedule for submittals in tabular format.
 - 1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
 - 2. Coordinate with Contractor's construction schedule and schedule of values.
 - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.12 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.

- B. Submit to Engineer/Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.13 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Engineer/Architect's knowledge as contract administrator or for Owner.

3.14 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.15 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Engineer/Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.16 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 3. Transmit using approved form.
 - a. Use Form AIA G810.
 - b. Use Contractor's form, subject to prior approval by Engineer/Architect.
 - 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.

6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format to Engineer/Architect.
 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Engineer/Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Engineer/Architect's approval, allow an additional 30 days.
 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 10. Provide space for Contractor and Engineer/Architect review stamps.
 11. When revised for resubmission, identify all changes made since previous submission.
 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 14. Submittals not requested will not be recognized or processed.
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Do not reproduce Contract Documents to create shop drawings.
 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.17 SUBMITTAL REVIEW

- A. Submittals for Review: Engineer/Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Engineer/Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Engineer/Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Engineer/Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:

- a. "No Exception Taken", or language with same legal meaning.
- b. "Make Corrections Noted, Resubmittal Not Required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
- c. "Make Corrections Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.
- 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Engineer/Architect's and consultants' actions on items submitted for information:
 - 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 - 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 01 3000

**SECTION 01 3216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Work sequence.

1.03 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016, with Addendum (2021).

1.04 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.
- F. Submit in PDF format.
- G. Submit under transmittal letter form specified in Section 01 3000 - Administrative Requirements.

1.05 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with five (5) years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.
- B. Contractor's Administrative Personnel: Five (5) years minimum experience in using and monitoring CPM schedules on comparable projects.

1.06 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches.
- C. Sheet Size: Multiples of 8-1/2 x 11 inches.
- D. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

- B. Identify work of separate stages and other logically grouped activities.
- C. Provide sub-schedules for each stage of Work identified in Section 01 1000 - Summary.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Engineer/Architect. Indicate decision dates for selection of finishes.
- G. Coordinate content with schedule of values specified in Section 01 2000 - Price and Payment Procedures.
- H. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Engineer/Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.06 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Engineer/Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION 01 3216

**SECTION 01 4000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Contractor's design-related professional design services.
- G. Control of installation.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Document 00 7200 - General Conditions: Inspections and approvals required by public authorities.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures.
- C. Section 01 4216 - Definitions.
- D. Section 01 4219 - Reference Standards.
- E. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2026.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2025.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025b.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2026.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2025.

1.04 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:

- a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
- b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary stairs or steps required for construction access only.
 - 5. Temporary hoist(s) and rigging.
 - 6. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Information to Engineer/Architect if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Section 21 1300 - Fire-Suppression Sprinkler Systems.

1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Engineer/Architect's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Engineer/Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 - 2. Include required product data and shop drawings.
 - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

- D. Test Reports: After each test/inspection, promptly submit electronic copies of report to Engineer/Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Engineer/Architect, provide interpretation of results.
 - 2. Test report submittals are for Engineer/Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Engineer/Architect, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer/Architect.
- F. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- G. Manufacturer's Field Reports: Submit reports for Engineer/Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Contractor's Quality Control (CQC) Plan:
 - 1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.

- 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
- b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.
 - 10) Project materials certification.
 - 11) Managerial continuity and flexibility.
- c. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

1.09 REFERENCES AND STANDARDS

- A. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- B. Obtain copies of standards where required by product specification sections.
- C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
 2. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 3. Laboratory: Authorized to operate in the State in which the Project is located.
 4. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.

- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer/Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

2.03 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Engineer/Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Engineer/Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Engineer/Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Engineer/Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Engineer/Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.04 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

2.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Engineer/Architect, it is not practical to remove and replace the work, Engineer/Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 4000

**SECTION 01 4100
REGULATORY REQUIREMENTS**

PART 1 GENERAL

1.01 SUMMARY OF REFERENCE STANDARDS

- A. Regulatory requirements applicable to this project are the following:
- B. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- C. State of South Carolina amendments to some or all of the below.
- D. City of York ordinances and amendments to some or all of the below.
- E. Zoning Ordinance: City of York.
- F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC (IECC) - International Energy Conservation Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC (IFC) - International Fire Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC (IFGC) - International Fuel Gas Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. Erosion and Sedimentation Control Regulations:.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements.

1.03 QUALITY ASSURANCE

- A. Contractor's Designer Qualifications: Refer to Section - 01 4000 - Quality Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 4100

**SECTION 01 4216
DEFINITIONS**

PART 1 GENERAL

1.01 SUMMARY

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

1.02 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Provide: To furnish and install.
- E. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 4216

**SECTION 01 4219
REFERENCE STANDARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Should specified reference standards conflict with Contract Documents, request clarification from the Engineer/Architect before proceeding.
- C. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Engineer/Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

END OF SECTION 01 4219

**SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Waste removal facilities and services.
- G. Project identification sign.
- H. Field offices.

1.02 TEMPORARY UTILITIES

- A. Owner will provide the following:
 - 1. Electrical power and metering, consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.
- B. Existing facilities may be used.
- C. New permanent facilities may be used.
- D. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.03 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Use of existing facilities is not permitted.
- C. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.09 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.10 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel at location directed by Owner. When site space is not adequate, provide additional off-site parking.

1.11 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location approved by Owner.
- C. No other signs are allowed without Owner permission except those required by law.

1.13 FIELD OFFICES

- A. Designated existing spaces may be used for field offices as directed by Owner.
- B. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- C. Provide space for Project meetings, with table and chairs to accommodate 8 persons.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations and grade site as indicated on drawings.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 5000

**SECTION 01 6000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

1.03 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
 - 1. Containing asbestos.
- C. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions.
 - 2. If wet-applied, have lower VOC content.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 6000

**SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- I. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- C. Division 07, Firestopping.

1.03 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Engineer/Architect 14 days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer/Architect, Owner, participants, and those affected by decisions made.

3.04 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Engineer/Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.

- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, and Electrical): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.

- L. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Division 07, Firestopping, to full thickness of the penetrated element.
- J. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections or as directed by Owner.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - Demonstration and Training.

3.11 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING

- A. Execute final cleaning prior to Substantial Completion.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.

- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Engineer/Architect and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Engineer/Architect when work is considered ready for Engineer/Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Engineer/Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Engineer/Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Engineer/Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Engineer/Architect when work is considered finally complete and ready for Engineer/Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Engineer/Architect listed in executed Certificate of Substantial Completion.

3.14 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 7000

**SECTION 01 7800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Specific requirements for operation and maintenance data.
- C. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Engineer/Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Engineer/Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit electronic sets of revised final documents in final form within 10 days after final inspection.
- C. Materials Transparency Manual:
 - 1. Compile and submit a digital version of information disclosing materials content for interior finishes. Meet IWBI (BS) requirements for format and content.
- D. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 3. Field changes of dimension and detail.
 4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.

- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into electronic PDF manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- D. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Engineer/Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- E. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- F. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- G. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- H. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- I. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION 01 7800

**SECTION 01 7900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

1.02 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Provider.
 - 2. Submit one copy to the Commissioning Provider, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Provider.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Provider in preparation of overall Training Plan; submit in editable .rtf or .docx electronic format unless otherwise approved.
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Commissioning Provider for review and inclusion in overall training plan.
 - 2. Submit not less than four weeks prior to start of training.
 - 3. Revise and resubmit until acceptable.
 - 4. Provide an overall schedule showing all training sessions.
 - 5. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Provider.
- D. Provide training in minimum two hour segments.
- E. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- F. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- G. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.

- H. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 7900

SECTION 02 4100

DEMOLITION

PART 1 GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the Contract and General Conditions and all Sections within Division 1 General Requirements, which are hereby made a part of this Section of the Specifications.
- B. Equality of material, article, assembly or system other than those named or described in this Section shall be determined in accordance with the provisions of the contract and general conditions.

1.02 DESCRIPTION OF WORK

- A. The Contractor shall provide labor, materials and equipment to complete the general and selective demolition of the building and selective demolition of site items as described. Generally, the demolition work shall include, but not be limited to:
 - 1. File all necessary notices, obtain all permits and licenses, and pay all governmental taxes, fees, and other costs in connection with the work. Obtain all necessary approvals of all governmental departments having jurisdiction.
 - 2. The Contractor, in the presence of the Architect or Owner, shall take photographs or record a video tape of existing conditions adjacent to the site, including sidewalks, curbing, utility structures, light poles, and other features.
 - 4. Removal and recycling/disposal of demolished materials are at the Contractor's expense. Except for those items specifically designated to be turned over to the Owner, all existing removed materials, items, trash, and debris shall become the property of the Contractor and shall be completely removed from the site and legally disposed, recycled, and salvaged at the Contractor's expense. Onsite sale of material is not permitted.
 - 6. Protection of site structures and features that are designated to remain.
 - 7. Scheduling and sequencing operations without interrupting utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner. Provide temporary services as necessary to serve occupied and usable facilities when permanent utilities must be interrupted, or schedule interruption when the least amount of inconvenience will result.
 - 8. Refer to project requirements on drawings for selective demolition. Coordinate activities to prevent damages to adjacent properties during selective demolition.

1.03 REFERENCE STANDARDS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

- A. American National Standard Institute, A10.6-2006, Safety Requirements for Demolition for Construction and Demolition Operations.
- B. National Fire Protection Association, 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.05 DEFINITIONS

- A. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract.
- B. ABC: Asphalt, Brick and Concrete
- C. ANSI: American National Standards Institute
- D. Coated ABC: Coated brick, concrete and concrete masonry units. Coatings shall include, but not be limited to: paint, stucco applications, plaster, etc.

- E. Demolition: Total or selective destruction of building or portions of buildings; removal of building materials for renovation projects
- F. Disposal: Removal off-site of demolition and construction debris and subsequent sale, recycling, reuse, or deposit in a permitted solid waste landfill or incinerator acceptable to authorities having jurisdiction.
- G. DOT: Department of Transportation
- H. Architect: Architect shall be the Architect of Record for the project. For this project DP3 Architects, Ltd. will serve as the Architect.
- I. IMPLOSION: Use of explosives for structure demolition.
- J. NFPA: National Fire Protection Association.
- K. OSHA: Occupational Safety and Health Administration
- L. Remove: Remove and reuse, recycle, treat and dispose of items except those indicated to be reinstalled, salvaged, or to remain on the Owner's property.
- M. Remove and Salvage: Items indicated to be removed and salvaged remain on the property. Carefully remove, clean, and pack or crate items to protect against damage. Prepare and attach all packed or crated items to wood pallets for outside storage. Identify contents of containers and deliver to the Owner's designated storage area.
- N. SCDHEC: South Carolina Department of Health and Environmental Control
- O. USEPA: United States Environmental Protection Agency

1.06 SCHEDULE

- A. The Contractor shall develop a demolition schedule for each phase of the work prior to the Pre-Construction Conference. The Owner and Architect shall approve any proposed alterations the work sequence to meet the specific needs of the project.
- B. The Contractor shall update the schedule and submit any schedule changes for review by the Architect at the weekly construction meetings.

1.07 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition that all recyclable demolition material shall be recycled and non-recyclable material shall be disposed at an approved facility.

1.08 SUBMITTALS

- A. The Contractor shall submit each item in this Article according to the Conditions of the Contract for information only, unless otherwise indicated.
- B. Shop Drawings:
 - 1. Scaffolding details
 - 2. Temporary shoring
- D. Quality Control Submittals (prior to commencement of onsite demolition):
 - 1. Methods of demolition and equipment proposed to demolish structure. Demolition means and methods must be approved by the Owner and Owner's Structural Engineer.
- E. Schedule of Demolition Activities:
 - 1. Detailed sequence of demolition and removal work, with early and late starting and finishing dates for each activity. Ensure onsite operations are uninterrupted if applicable.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Locations of proposed dust- and noise-control temporary partitions and means of

egress.

5. Means of protection for items to remain and items in path of waste removal from building.
- F. Inventory: After demolition is complete, submit a list of items that have been removed and salvaged and where the material will be delivered for disposal and/or recycling.
- G. Pre-Demolition Photographs or Videotapes: Show existing conditions in sufficient detail of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.09 REGULATORY REQUIREMENTS

- A. The Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction over demolition prior to starting work including, but not limited to local, state and federal agencies.
- B. Comply with all applicable federal, state, and local safety and health requirements regarding the demolition of structures and other site features as applicable.
- C. Notify the Owner and Architect immediately upon discovery of any hazardous materials detected on site.

1.10 QUALITY ASSURANCE

- A. Qualifications
 1. Extreme care shall be taken with removal work to ensure against damage to existing materials to remain in place. Engage workmen who will work diligently and carefully to protect the building.
 2. Procedures and administration requirements of this section apply to all sections of specifications that are involved in alterations to building.
 3. Assign work of moving, removal, cutting, patching, and repair to trades so as to cause least damage to each type of work encountered, and to return building as much as possible to appearance of new work.
 4. Patching of finish materials shall be assigned to mechanics skilled in work of finish trade involved.
 5. Employ personnel to survey or verify condition of structures who shall be competent to determine both condition of framing, floors, and walls, and possibility of unplanned collapse of any portion of structure and who shall have authority to take prompt corrective action if necessary.
- C. Examination of Existing Conditions: The Contractor shall examine the Drawings for demolition and removal requirements and provisions for new Work. Verify all existing conditions and dimensions before commencing Work. The Contractor shall visit the site and examine the existing conditions and shall inform herself/himself of the character, extent and type of demolition and removal Work to be performed. The Contractor shall submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.
- D. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- E. Regulatory Requirements: Comply with governing USEPA and SCDHEC notification regulations before beginning demolition. Comply with local, state and federal hauling and re-use/recycling/treatment/disposal regulations. Standards: Comply with ANSI A10.6 and NFPA 241.
- F. Pre-demolition Conference: Conduct conference at the Site. Review methods and procedures related to selective demolition including, but not limited to, the following:
 1. Inspect and discuss condition of construction to be demolished.
 2. Review structural load limitations of existing structure.

3. Review and finalize demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by demolition operations.

1.11 PROJECT CONDITIONS

- A. The Owner/Architect/Engineers assume no responsibility for actual condition of buildings or portion of buildings to be demolished.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by the Owner as far as practical.
- C. Existing Conditions:
 1. Conduct demolition and removal to minimize interference with adjacent building areas. Maintain a protected egress and access at all times.
 2. Disconnect, remove and cap existing utility services within areas of demolition.
- E. Unforeseen Conditions:
 1. Should unforeseen conditions be encountered that affect design or function of Project, investigate fully and submit an accurate, detailed, written report to Architect which includes changes in the cost of the work and/or schedule if any exist.
 2. While awaiting Architect's response, reschedule operations if needed to avoid delay of overall Project.
 3. Do not proceed with work related to unforeseen conditions until the Architect issues a response.

1.12 DEMOLITION BY IMPLOSION

Use of explosives will not be allowed on this project.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials required to complete the work under this Section shall conform to the standards and requirements of local codes, ordinances, municipalities, regulatory agencies, utility companies and other agencies having jurisdiction over the work to be performed.
- B. New Materials:
 1. Materials shall be as specified in other specification sections contained in this Project Manual.
 2. Match existing products and work for patching and extending work.
- C. Existing Products:
 1. Determine type and quality by inspection and testing of existing products, referring to existing work as a standard.
 2. Where a product or type of construction occurs in existing building, and is not specified as part of new work, provide such products or types of construction as needed to patch, extend, or match existing work.
 3. This specification will generally not describe existing products or standards of execution, nor enumerate products that are not a part of new construction. Existing product is its own specification.

PART 3 EXECUTION

3.01 GENERAL

- A. Verify site conditions before proceeding with demolition work. Inspect structure and utilities prior

to start of work and notify the Architect in writing, of any hazardous conditions and/or discrepancies.

1. Unknown Site Conditions - The information provided in the drawings is believed accurate, but the Contractor should field verify all information. The Contractor shall bear full responsibility for obtaining all locations of utilities and their connections. Services to buildings outside the Limits of Work shall be maintained and all resulting costs or charges shall be the responsibility of the Contractor.
 2. Interior Elements - Interior features including but not necessarily limited to structural elements, walls, partitions, equipment, piping or other building facilities must be visually inspected prior to submittal of bid, and again prior to initiation of on-site work. The Contractor shall be responsible for performing its own inspection and appraisal of all features and facilities to be demolished or removed for salvage. The Contractor shall also investigate to assure itself of the condition of the work to be demolished and shall take all precautions necessary to ensure safety of people and property.
- B. The demolition of building components and related appurtenances shall be accomplished by methods which will not cause damage to surrounding structures, underground and overhead utilities, or other existing items and structures that are to remain in place. All debris shall be promptly and properly managed as the demolition progresses. Construct and/or prepare material Staging/Stockpile areas as required at locations approved by the Owner.

3.02 WORK RESTRICTIONS

- A. Burning is not permitted.

3.04 PREPARATION

- A. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities. Damage or impact to any public or private property including sidewalks, roadways, landscape areas, or buildings/structures will be immediately repaired at no cost to the Owner.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the city and/or SCDOT, as applicable. Provide alternate routes around closed or obstructed traffic ways as required by governing regulations. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
 2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways to limit site access to the general public.
 3. Protect existing site improvements and appurtenances to remain.
- B. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability prevent unexpected or uncontrolled movement or collapse of construction being demolished and as required to prevent damage to adjacent buildings, structures, or property not part of this work. All shoring, bracing, and structural supports shall be designed by a South Carolina licensed structural engineer and submitted to the Architect for review at least 10 working days prior to initiating demolition activities.
1. Strengthen or add new supports when required during progress of demolition.
 2. Remove temporary shoring, bracing and structural supports when no longer required.
 3. Post warning signs and place barricades as applicable during placement and removal of temporary shoring.
 4. Conform with OSHA safe excavation and excavation support regulations for any and all shoring work.
- C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition activities.

1. Erect temporary protection, such as walks, fences, and overhead protection (if applicable) where required by authorities having jurisdiction. Provide temporary barricades as required to limit access to demolition areas.
- D. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

3.05 DEMOLITION

A. General Requirements:

1. Demolish and remove existing items as noted on the drawings.
2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
5. Dispose of demolished items and materials promptly.

B. Structure Demolition

1. Demolish and completely remove items designated on the drawings within the Limit of Work. Selective demolition shall include the demolition of structural and non-structural building elements, certain mechanical systems, equipment, other items within the building, and appurtenances and ancillary components within, and fixed to, the building except as otherwise specified herein. As noted, equipment and other items within the building shall be demolished as required and removed for reuse, recycling, or lawful disposal.
 2. Coordinate selective demolition requirements as shown on the drawings.
 3. All building foundation components and related elements including any floor slabs shall remain in-place.
 4. Ensure no unstable building elements are left unsupported. Place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this Contract. During demolition, the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, or other structural element shall be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.
- D. All demolition debris is to be disposed offsite at an appropriate waste disposal and/or recycling facility. No crushing operations will be permitted on the site except as necessary to reduce material to a size suitable for offsite shipment.
- #### **B. Salvage**
1. Salvage all original materials removed from the building for reuse on the project or for storage.
 2. Salvage, label and store materials as directed by the Architect and the Owner.
 3. Remove materials to be reinstalled or retained and store in a manner to prevent damage.

3.06 REPAIR/RESTORATION

A. General Requirements:

1. Coordinate work of alterations and renovations to expedite sequential completion of work.

2. Remove, cut, and patch work in a manner to minimize damage and to provide a means of restoring products and finishes to original condition.
- B. Reuse of Existing Salvaged Materials:
 1. Save cut or removed material to replace damaged work or patch new work as needed.
 2. Incorporate used materials in new construction as specified to greatest extent possible before new material is used.
- C. Transitions:
 1. Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance so as to make patch or transition invisible to eye from a distance of 20 feet (6 m).
 2. Where a change of plane of 1/4" (6mm) or more occurs, submit recommendation for providing a smooth transition for Architect's acceptance.
- D. Finishes:
 1. Finish surfaces and substrates as specified In Individual product sections.
 2. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest Intersections.

3.07 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 1. Verify that construction and utility arrangements are as shown.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- C. Remove existing work as indicated and as required to accomplish new work.
 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 2. Remove items indicated on drawings.
- D. Services: Remove existing systems and equipment as indicated.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.

- F. **Miscellaneous Site Demolition:** Remove and properly dispose of all miscellaneous debris, miscellaneous solid waste, abandoned supplies, equipment, or other materials located within the Limit of Work, including the interior of the building to be demolished.

3.08 DISPOSAL

- A. Disposal of Demolition Materials Removed from Site - Reuse, recycle, treat and dispose all materials from demolition (i.e. metals, wood, concrete, miscellaneous waste, etc.) as well as all equipment and other materials that are within the building. The loading of demolition materials shall be performed in a manner that prevents materials and activities from generating excessive dust and ensure minimum interference with roads, sidewalks and streets both onsite and offsite.
- B. Facility Documentation - Provide evidence, on an on-going basis, that demolition materials have been received at the designated recycle, reuse, salvage or disposal facility. Documentation shall include but not be limited to weight receipts, manifests, bills of lading, etc. Transport of all materials off-site shall be in accordance with applicable DOT Regulations. All materials leaving the site shall become the property of Contractor unless otherwise specified herein.

3.09 BACKFILLING

Not applicable.

3.10 DUST CONTROL

The Contractor shall implement fugitive dust suppression to prevent unacceptable levels of dust resulting from demolition operations or other activities required by the Contract. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to visually monitor airborne particulate matter.

3.11 CLEANUP

As soon as Work in each area of alteration is complete, clean up surfaces, remove equipment, salvage and debris, returning those areas to a good condition suitable for use.

3.12 PROTECTION

- A. Protect remaining finishes, equipment and adjacent work from damage caused by cutting, moving, removal, and patching operations. Protect surfaces that will remain a part of finished work.

3.13 WASTE MANAGEMENT

- A. Debris:
1. Load debris resulting from cutting, moving, or removal into a disposal container for removal from the site. Dispose of removed materials legally. Do not burn materials at Site. Do not let piled material endanger structure. .
 2. Prevent occurrence of unsanitary conditions or damage due to debris.
 3. Remove demolished materials from site weekly as Work progresses. Upon completion of Work, leave areas in a clean condition.
- B. Items listed below have unique or regulated disposal requirements and are to be removed and disposed of in manner dictated by law or in most environmentally responsible manner. Typical concerns are listed in parentheses:
1. Batteries (lead, acid, mercury)
 2. Paints, solvents, and other hazardous fluids
 3. Corrugated cardboard
 4. Materials with lead based paint finishes.
 5. Asbestos containing materials.

END OF SECTION 02 4100

SECTION 02 8713 MOLD REMEDIATION

PART 1 - GENERAL

1.01 SUMMARY

In performing this project, all possible safeguards, precautions and protective measures shall be utilized to prevent exposure of any individual to mold particulates.

1.02 SCOPE

Provide mold remediation work including the handling and control of mold contaminated materials and the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with mold products and spores. The work also includes the disposal of any mold contaminated materials generated by the work. The mold removal work includes the demolition and cleaning of impacted areas, as identified in the drawings and the recommendations contained in the ***"Indoor Air Quality Investigation" prepared by UES Professional Solutions 29, Inc. dated April 1, 2026.*** Provide containment and engineering control techniques as outlined in this specification.

The following microbial remediation specifications apply to the cleaning / removal and disposal of fungally-contaminated porous, semi-porous and non-porous surfaces. The level of containment and requirements for cleaning and remediation of materials will depend on the condition of the space and materials being remediated.

A microbial remediation plan must be prepared for approval by the Contractor's Environmental Consultant. Microbial remediation plan shall include an assessment of the risk for people to occupy areas adjoining the remediation area while remediation work is occurring.

This specification section includes the protocol regarding proper disposal of the removed building material components from within the work site.

Use proper cleaning procedures, engineering controls, and apply best management practices to remove microbial growth and spore fallout from all surfaces and building materials to minimize the further release of microbial spores. Address semi-porous and nonporous surfaces within the facility in each cleaning phase of the project. Damp wipe and HEPA vacuum all surfaces, at a minimum. Remove and dispose of porous building materials that are supporting microbial growth.

1.03 GENERAL REQUIREMENTS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

- A. AIHA IMOM08-679: (2008) Recognition, Evaluation, and Control of Indoor Mold.
- B. ASSE Z9.2: (2012) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems.
- C. IICRC S100: (2002) Standard Reference Guide for Professional Carpet Cleaning.

- D. IICRC S500: (2006) Standard and Reference Guide for Professional Water Damage Restoration.
- E. ACR: (2013) Standard for Assessment, Cleaning, and Restoration of HVAC Systems.
- F. 29 CFR 1910.134: Respiratory Protection.
- G. 29 CFR 1926.1101: Asbestos.
- H. UL 586: (2009) Standard for High-Efficiency Particulate, Air Filter Units.

1.04 DEFINITIONS

- A. AIHA: American Industrial Hygiene Association.
- B. AFU: Air filtration unit with High Efficiency particulate air (HEPA) filtered vacuum and / or exhaust ventilation equipment with a filter system capable of collecting and retaining microbial contamination ASSE Z9.2. Filters shall retain 99.97 percent of particles 1.2 by 10-6 inch or larger as indicated in UL 586.
- C. Categories of Water (IICRC S500)
 - 1. Category 1 Water: Water originating from a source that does not pose substantial harm to humans. Also referred to as "clean water."
 - 2. Category 2 Water: Water containing a significant degree of chemical, biological and/or physical contamination and having the potential to cause discomfort or sickness if consumed by or exposed to humans. Also referred to as "gray water."
 - 3. Category 3 Water: Grossly unsanitary water, containing pathogenic agents, arising from sewage or other contaminated water sources and having the likelihood of causing discomfort or sickness if consumed by or exposed to humans. This category includes all forms of seawater, ground surface water and rising water from rivers or streams. Also referred to as "black water."
- D. Complete Interior Building Demolition (Complete Gut): Interior finishes of the building have been removed to expose basic structural elements.
- E. Containment: Physical separation and engineering controls required to prevent contamination of undamaged materials and occupied areas. The level of containment varies depending on the extent of the contamination.
 - 1. Source Containment: Use when the contaminated surface area is less than 10 square feet, in non-residential buildings only. At a minimum, source containment shall include the following:
 - a. Isolation of Work Areas. Install polyethylene barriers to isolate the areas or material to be demolished / remediated from non-remediation areas.
 - b. Floor protection. Maintain protection for finished floors through

all construction activities.

- c. HEPA vacuum to control dust created during the demolition. Hold HEPA vac intake at source of dust.
2. Limited Containment: Use when contaminated surface area is between 10 square feet and 100 square feet per room in non-residential buildings and contaminated surface area less than 100 square feet per room in residential buildings. At a minimum, limited containment shall include the following:
- a. Containment. For residential buildings, a containment shall include the entire room where work is being performed. The containment shall not extend past the extents of the room unless there are instances of contamination extending from one room to the next. For non-residential buildings, the containment shall include the area to be remediated, plus enough additional area to allow for all equipment and work activities.
 - b. Isolation of Work Areas. Install polyethylene barriers to isolate the areas to be demolished / remediated.
 - c. Floor protection. Maintain protection for finished floors through all construction activities.
 - d. Air Filtration / Pressurization Control. Install AFUs with HEPA filters in the containment. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column maximum relative to the outside and other adjacent spaces not undergoing remediation. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.
 - e. Protection for all items remaining in the containment. Protective devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.
 - f. Containment Entrance. Install a triple-flap poly "door" to be used during demolition to minimize egress and provide a good separation between containment and occupied areas of the house / building.
3. Full Containment: Use when contaminated surface area is greater than 100 square feet in both residential and nonresidential buildings. At a minimum, full containment shall include the following:
- a. Containment. For residential buildings, a containment shall include the entire room where work is being performed. The containment shall not extend past the extents of the room unless there are instances of contamination extending from one room to the next. For non-residential buildings, the containment shall

- include the area to be remediated, plus enough additional area to allow for all equipment and work activities.
- b. Isolation of Work Areas. Construct polyethylene barriers to isolate the areas to be demolished / remediated.
 - c. Floor protection. Maintain protection for finished floors through all construction activities.
 - d. Air Filtration / Pressurization Control. Install AFUs with HEPA filters in the containment. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column maximum relative to the outside and other adjacent spaces not undergoing remediation. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.
 - e. Protection for all items remaining in the containment. Protective devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.
 - f. Decontamination. Construct a decontamination airlock for entry into and exit from the work area. The airlock shall be used to HEPA vacuum the sealed bags of contaminated debris. When possible, the decontamination airlock shall be located so that the sealed bags can be passed directly from the airlock to the outside, through a door or window.
 - g. Containment Entrance. Install a triple-flap poly "door" at the entrance to the airlock, and between the airlock and the work area during demolition to minimize egress and provide a good separation between containment and occupied areas of the house / building.
4. Unoccupied Building Containment: Use when a building is unoccupied and large amounts of mold growth are present throughout the building:
- a. Containment. The containment consists of the entire building. Install AFUs with HEPA filters in the building. Configure the AFUs to recirculate within the active remediation area. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour based on the size of the area undergoing active remediation.
 - b. Isolation of Work Areas. Install polyethylene barriers to isolate the areas where remediation is not required. AFU discharge may be used to positively pressurize non-remediation areas from areas undergoing remediation to prevent the movement of spores into "clean" areas.
 - c. Floor Protection. Maintain protection for finished floors through all construction activities.

- d. Protection for all items remaining in the containment. Protective devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.
 - e. Decontamination. Construct a decontamination airlock for entry into and exit from the building.
 - f. Containment Entrance. A triple-flap poly "door" shall be used at the entrance to the work area during demolition to minimize egress.
5. Cleaning Containment: A temporary containment structure set up to clean items removed from the containment. At a minimum, the cleaning area shall contain:
- a. Two chambers. Construct walls with polyethylene. Items will be cleaned in the first chamber. The clean items shall be stored in the second chamber.
 - b. Air Filtration / Pressurization Control Cleaning Chamber. Install AFUs with HEPA filters in the cleaning chamber. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column (maximum) relative to the storage chamber.
 - c. Air Filtration, Storage Chamber. Install AFUs with HEPA filters in the storage chamber. The AFUs shall be configured to allow air to recirculate within the chamber. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.
 - d. Containment Entrance. Install a triple-flap poly "door" at the entrance to the cleaning chamber, between the cleaning and storage chambers, and at the exit of the storage chamber to minimize egress and provide a good separation between the chambers.
6. Decontamination Unit (Airlock): An enclosed area adjacent to, and connected to, a regulated work area. It consists of various rooms that are used for the decontamination of workers, equipment, and materials.
7. Dehumidifier: Mechanism or machine to remove moisture from the air.
8. Detergent: A cleaning agent. The term refers to a prepared compound that may include surfactants, builders, dry solvents, softeners, etc, but does not include true soap.
9. Disinfectants or Biocide Sanitizing Solutions: One of three groups of antimicrobials registered by the EPA for public health uses. The EPA considers an antimicrobial to be a disinfectant when it

destroys or irreversibly inactivates infectious or other undesirable organisms, but not necessarily their spores.

10. EPA: U.S. Environmental Protection Agency.
11. Fungicidal Agents, (EPA): A coating material that contains an EPA registered fungicide that inhibits the spread and growth of mold with the ability to withstand moist and humid conditions.
12. HEPA Filter: A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97 percent of all particulate larger than 1.2 by 10⁻⁶ inch.
13. HVAC: Heating, Ventilating, and Air Conditioning (System).
14. Microbial Remediation Supervisor: Individual responsible for the execution of the microbial remediation work as defined by the scope of work. This individual shall have documented training in microbial remediation and have at least three years experience in microbial remediation work. Remediation contractor's on-site supervisor shall have one of the following certifications: Council-Certified Mold Remediator (CMR), or Council-Certified Mold Remediation Supervisor (CMRS) as certified by the American Council for Accredited Certification, or Applied Microbial Remediation Specialist (AMRS), Institute of Inspection, Cleaning, and Restoration Certification (IICRC) or equivalent.
15. Non-Porous Material: A material that does not absorb nor is easily penetrated by liquids, especially water. Generally, non-porous materials have a permeable factor of less than 1. Some examples are metal, glass, plastic, ceramic tile, etc.
16. Occupied Spaces (Areas): The phrase "occupied space" within this specification refers to spaces that are occupied by unprotected non-remediation personnel while work is in progress. It also refers to areas adjacent to work areas that are not currently undergoing remediation.
17. Personal Protective Equipment (PPE): Any material or device worn to protect a worker from exposure to, or contact with, any harmful material or force. PPE must be cleaned or disposed of prior to removal from the remediation work area.
18. Poly: Polyethylene sheet with a minimum thickness of 6 mils.
19. Porous Material: Permeable materials having the physical properties that allow liquids or gasses to pass through. These materials include but are not limited to the following: gypsum wall board, insulation, wallpaper, ceiling material, carpet, padding, paper goods (i.e., cardboard boxes, loose paper, books, etc.), stuffed furniture, wicker, fabrics, etc.
20. Pressure Differential Measuring Instrument: Device used to measure the relative pressure difference between the work area and areas outside the work area. For mold remediation, the device must measure accurately in the 0 to 0.04 inch range.

21. Semi-porous Material: A material that can absorb liquids if exposed over long periods of time. These materials include but are not limited to wood, concrete, linoleum, vinyl wall covering, wooden or hardboard furniture, plaster, etc.
22. Ventilation System Mold Remediation Qualifications (VSMR): An individual certified by the North American Duct Cleaning Association (NADCA) to clean HVAC systems.
23. Work Area: The area where remediation operations are actively performed and controlled to prevent the spread of dust / spores and entry by unauthorized personnel.

1.05 SUBMITTALS

- A. Schedule: Submit schedule indicating proposed methods and sequence of operations for selective demolition work to the Architect for review prior to commencement of work. Include coordination for temporary shut-off and continuation of utility services as required, together with details for dust and noise control protection.
- B. Preconstruction Submittals: Within ten (10) days from the award of the contract and prior to the start of the work, submit to the Architect six copies of the following items for review and permanent file.
 1. Microbial Remediation Plan: Submit a job-specific, Mold Remediation Plan approved by the Contractor's Environmental Consultant to the Architect for final approval prior to start of work. The plan shall address the following items at a minimum:
 - a. Description of materials to be remediated, providing location and quantities (map if available), and methods to be used for remediation.
 - b. Types of biocides and fungicidal agents.
 - c. Containment procedures to include description and locations of engineering controls and decontamination unit to include entry and exit procedures (provide sketch of floor plan showing location of containment barriers and decontamination units). Plan shall include locations of AFUs and AFU discharges to the outside.
 - d. Description of personal protective equipment to be used during the remediation.
 - e. Construction barricades and barriers in occupied areas.
 - f. HVAC Shut down and start-up procedures.
 - g. HVAC Evaluation and remediation procedures.
 - h. Moisture and relative humidity control procedures and

equipment.

- i. Packaging and disposal procedures.
 - j. Safety Precautions to include lockout / tag-out, fall protection, confined space entry procedures, and fire protection.
 - k. Description of the method to be employed to control cross contamination of areas not in the work area. This shall include a risk assessment related to the suitability of people to occupy areas adjoin the remediation area while remediation activities are ongoing.
 - l. Quality Control procedures to include visual inspection.
- 2. Respiratory Protection Program: Provide written copy of Contractor's Respiratory Protection program.
 - 3. Worker Records: Provide the following documents for all workers, including supervisory personnel. If new workers are added to the crew, provide the same documentation for them.
 - 4. Employee Instruction and Release Form: Provide documentation showing that each employee has been instructed on the following items:
 - a. Use and fit of respirators (for employees entering and working in the containment).
 - b. Protective clothing.
 - c. Protective measures.
 - d. Safety and Emergency Egress Procedures.
 - e. Site specific fall protection plan and training.
 - f. Microbial remediation hazards and practices including engineering controls and isolation. Training should include "hands on" training for microbial remediation supervisors.
 - g. Workers' release forms stating the potential hazards involved with the scope of the work.
 - h. Worker Training Certification: Submit copies of training certificates for each employee indicating that the employee has received training at the appropriate level for the work prescribed in the description of work.
 - 5. Microbial Remediation Supervisor Qualifications: Onsite supervisor shall have one of the following certifications: Certified Mold Remediator (CMR), Certified Mold Remediation Supervisor (CMRS), or Applied Microbial Remediation Specialist (AMRS). Submit copies of supervisory training certificates.

- C. Product Data: Within 10 days of contract award, submit product data for items

identified for use in Microbial Remediation Plan.

- D. Daily Reports: Prepare a written report for each day that microbial remediation work is being accomplished. Submit this report to the Architect the following day, attached to the Contractor Quality Control Report. Referred to collectively as the Daily Report, the report at a minimum shall include measurements of differential pressure and temperature and relative humidity in work areas, and detail any non-compliance issues observed.
- E. Submittals at Completion of Remediation Work: Within 14 days of completion, provide the following information:
 - 1. Supervisor Logs.
 - 2. Daily Reports.
 - 3. Photographic Logs.
 - 4. Contractor's Industrial Hygienist Report certifying the microbial remediation is complete.

1.06 RECORD KEEPING: A Daily Project Log shall form a permanent record of the project. Secure and maintain these logs and any other required documentation as part of the permanent project file.

Daily Log: The Microbial Remediation Supervisor shall maintain a Daily Project Log. The Daily Project Log shall be used each day of the project to document the following information.

- 1. Date.
- 2. Name of Microbial Remediation Supervisor.
- 3. Name of Industrial Hygienist monitoring work area.
- 4. Number of workers on site.
- 5. Equipment utilized.
- 6. Brief description of daily work activities.
- 7. Listing of any non-compliance noted, emergencies, stop work orders (with detailed explanation), and descriptions of any other significant events.

PART 2 - PRODUCTS

- 2.01 DISINFECTANTS, BIOCIDES, SANITIZING SOLUTIONS AND FUNGICIDAL AGENTS, (EPA):** Shall be approved by EPA for the use detailed in the Microbial Remediation Plan and used in accordance with the manufacturer's specifications.

PART 3 - EXECUTION

- 3.01 EQUIPMENT:** Provide protective clothing and respirators as required by the Microbial Remediation Plan for use by any authorized visitors. Provide manufacturer's certificate of compliance for all equipment used to contain the microbial contamination. Contractor shall not be required to certify that visitors entering work areas be capable of wearing respirators.

- A. Respirators: Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. Provide personnel engaged in set-up, pre-cleaning, cleanup, handling, and removal of contaminated materials with the appropriate respiratory protection as specified in 29 CFR 1910.134. Microbial remediation plan shall consider Table 17.1 in AIHA IMOM08-679 "Recognition, Evaluation, and Control of Indoor Mold", which lists the minimum levels of respiratory protection based on the activity and size of the remediated area.
- B. Protective Clothing: Provide all workers with protective clothing as appropriate for the work being accomplished, as required by the Microbial Remediation Plan.

Do not permit any person to enter the work area without the appropriate protective clothing and equipment.

- C. Warning Signs and Labels: Provide bilingual warning signs printed in English and Spanish at all approaches to the work areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Warning signs may be in the form of continuous plastic tape. The warning signs shall have black characters on a yellow background.

**WARNING
DO NOT ENTER
MICROBIAL REMEDIATION WORK IN PROGRESS**

- D. Dehumidifiers: Install and use dehumidifiers as needed during the remediation to maintain relative humidity below 60 percent in the work area. Drain the condensate water to a permanent drain, or empty as needed to prevent water overflowing from the dehumidifiers.
- E. Air Filtration Units (AFU): Install and use AFUs with HEPA filters, and manufacturer specified pre-filters, as part of the exhaust ventilation system to develop and maintain the specified desired air pressure differential inside the enclosed work area relative to the outside areas. The Contractor shall be responsible for acquiring and paying for any licenses needed for use of any equipment, including but not limited to, air pressure differential systems and air filtration systems.

Replace HEPA filters and pre-filters for AFUs as required to maintain pressurization performance requirements during demolition and cleaning. Do

not reuse filters. Bag used filters at a minimum in clear 6 mil polyethylene bags within the containment and disposed as contaminated waste.

Discharge air from any AFUs located in the work area containment to the outside environment when creating a negative pressure containment to create a negative pressure relative to occupied areas of 0.02 inch H₂O to 0.04 inch H₂O. Discharge air in excess of that required for creating the proper negative pressure to the work area. The AFUs shall provide four to six air changes per hour in the work area. Under no circumstances may air from AFUs discharge to an occupied area. Coordinate location of window sashes or doors required for discharge openings with the Architect. Seal around openings used for discharge of exhaust air airtight. Exhaust discharge openings may be constructed of plywood.

Seal all exhaust and intake openings in AFUs with one layer of 6-mil polyethylene sheeting when not in use.

- F. Vacuum Cleaners Equipped with HEPA Filters: Provide vacuum cleaners equipped with HEPA filters designed for continuous operation to perform the work in a timely and efficient manner.

Provide nozzle attachments as required to adequately remove all dust. As a minimum, nozzle attachments shall include crevice and extended bristle brush nozzles. Any vacuum that is not equipped with a HEPA filter shall not be used at anytime.

Provide sufficient vacuum cleaners equipped with HEPA filters designed for continuous operation in the work area during microbial remediation inside the containment area.

Provide additional vacuum cleaners equipped with HEPA filters in the enclosed work area during remediation or cleaning work as required by the size (area) of the containment and to maintain timely progress of the work.

3.02 GENERAL REQUIREMENTS

- A. Pre-Microbial Remediation Work Conference: Meet with the Architect prior to beginning work to discuss in detail the Microbial Remediation Plan, including work procedures and safety precautions. Once approved by the Architect, the plan shall be enforced as if a part of this specification. Any variances to the specification as a result of the plan shall be specifically identified to allow for free discussion and approved by the Architect in writing prior to starting work.
- B. Containment Entry / Exit Procedure: Ensure that each worker and authorized visitor follows entry and exit procedures detailed in the Microbial Remediation Plan.

3.03 REMOVAL PROCEDURES

- A. Protection of Existing Work Areas: Perform work in a manner to minimize the damage or contamination to areas outside or directly adjacent to the work area. Contractor is required to inspect areas inside and outside proposed work areas to identify existing damage and notify Architect prior to start of work.

Where materials outside work area are damaged or contaminated as a result of the Contractors work efforts as verified by the Architect using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Owner as deemed appropriate by the Architect. Should adjacent or outside areas become contaminated as a result of the Contractor's work efforts the work shall stop immediately. The newly contaminated areas shall be cleaned and verified by visual inspection by the Environmental Consultant. The work may proceed at the discretion of the Architect once the area has been verified as restored.

B. Remediation of Fungally Contaminated Building Materials: The removal of contaminated materials shall follow in general the listed sequence of work. The Contractor may make changes to improve workflow with the approval of the Architect.

1. Provide level of containment and PPE required by the Microbial Remediation Plan.
2. Disable all HVAC units and exhaust fans in the area to be remediated.
3. Protect materials to remain in work area. Where possible, all materials to be salvaged should be cleaned in place to prevent possible cross-contamination created by moving materials through non-remediation areas.
4. Remove undamaged items and materials to be cleaned and salvaged from the work area. Materials shall be stored in an area with relative humidity maintained below 60 percent and where temperatures will not damage the material. Notify Architect of existing damage to items prior to removal.
5. Set up containments, including protection of materials remaining within the containment and AFUs. Notify Architect that the area is prepared for remediation activities.
6. Pre-demolition inspection by the Environmental Consultant and/or Architect.
7. Demolition and removal / cleaning of contaminated materials.
8. Post-remediation inspection by the Environmental Consultant and/or Architect.
9. Perform final cleaning in the containment.
10. Clean carpet in the containment.
11. Clearance inspection by the Environmental Consultant and/or Architect.
12. Duct and HVAC cleaning, if necessary.
13. Deconstruction of containment, removal of AFUs.
14. Clean previously removed items prior to returning to occupied area.

- C. Remediation Procedures: Procedures for remediation depend on the amount of mold growth and the type of material with fungal growth.
1. Remediation of Non-Porous Materials: The method of remediating non-porous items shall be:
 - a. HEPA vacuum all surfaces.
 - b. Damp wipe all surfaces using clean water or a detergent solution.
 2. Semi-Porous Materials (Unfinished Wood): The method of remediating unfinished wood-based items, including wood and wood framing in wall cavities, shall be:
 - a. Cleaning:
 - (1) HEPA vacuum all surfaces.
 - (2) Scrub surfaces with a brush and detergent to remove mold.
 - (3) HEPA vacuum all surfaces to remove dust.
 - (4) Repair finishes as required to match original.
 - b. Removal: Where unfinished wood product has been structurally damaged, remove and replace with an equivalent product. This shall include wall studs and sheathing, such as OSB used in flooring, wall, or roof construction.
 3. Semi-Porous Materials: The method of surface cleaning semi-porous materials such as concrete, vinyl wall covering, linoleum, leather furniture, and finished wood products shall be:
 - a. HEPA vacuum all surfaces.
 - b. Damp wipe surfaces with using clean water or a detergent solution. Avoid over-wetting the material.
 4. Porous Materials
 - a. Carpet:
 - (1) Removal: Replace carpet that has remained wet for 48 hours or longer.
 - (2) Cleaning: Use a dry absorbent compound cleaning method as designated by IICRC S100. This method uses an absorbent compound to dissolve, suspend and absorb carpet soils. It does not add moisture back into the carpet.

- b. Gypsum Wallboard (GWB):
 - (1) Removal: Replace Gypsum Wallboard that has remained wet for 48 hours or longer, or has visible mold growth. Where removal of GWB exposes insulation, remove and replace the insulation with an insulation having equal characteristics for insulating value and permeability.
 - (2) Surface Cleaning: Where GWB has a small amount of surface mold growth and the GWB is structurally sound, a surface cleaning method may be used with the permission of the Environmental Consultant and/or Architect. The method of surface cleaning GWB shall be HEPA vacuum all surfaces. Surface cleaning shall not be used where mold growth penetrates wallboard substrate.
- c. Ceiling Tile:
 - (1) Removal: Replace ceiling tile that has remained wet for 48 hours or longer, or has visible mold growth.
 - (2) Surface Cleaning: Where settled dust on ceiling tiles contains mold spores and the ceiling tile is structurally sound, is not sagging, and has not been wet, a surface cleaning method may be used with the permission of the Environmental Consultant and/or Architect. The method of surface cleaning ceiling tile shall be HEPA vacuum all surfaces. Surface cleaning shall not be used where mold growth is occurring on ceiling tiles.
- d. Paper Materials: Discard paper materials that have remained wet for 48 hours or longer, or that have visible mold growth.
- e. Textiles:
 - (1) Discard textiles with visible mold growth.
 - (2) Clean textile based items, including clothing, linens, and toys that do not have visible mold growth, but have been wet, in standard commercial or residential washing machines with standard washing machine detergent.
 - (3) Dry all items completely before returning to the building / house.
 - (a) When possible, use dryers to dry items.
 - (b) If dryers will cause irreversible harm to the item, hang the item on a drying rack in a temperature and humidity controlled space. Discard items not dry within 48 hours.
- f. Upholstered Furniture:

- (1) Removal: Discard upholstered furniture that has remained wet for 48 hours or longer, or that have visible mold growth.
- (2) Cleaning: Clean upholstered furniture that has been exposed to mold spores but does not have visible mold growth by HEPA vacuuming upholstery and wood or metal structure, followed by a damp wipe of semi-porous or non-porous portions of the furniture.

3.04 DETAILED SEQUENCE OF WORK FOR MOLD REMOVAL UNDER CONTAINMENT

A. Preparation for Remediation Work:

1. Provide level of containment and PPE required for the remediation based on the Microbial Remediation Plan.
2. Disable all HVAC units and exhaust fans in the area to be remediated.
3. Remove undamaged materials from the work area if they are to be salvaged but cannot be cleaned in place. Store materials in an area with relative humidity maintained below 60 percent and where temperatures will not damage the material. Notify Architect of existing damage to items prior to removal. Clean materials using procedures detailed in Remediation Procedures.
4. Remove supply diffusers, return grilles and exhaust grilles. Clean diffusers and grilles using procedures detailed in Remediation Procedures.
5. Construct containment barriers. Existing walls can be used as a portion of the containment barriers if existing openings in walls (such as doors, wall openings, vents, etc.) are sealed using polyethylene.
6. Install the AFUs and dehumidifiers.
7. Seal supply, return, and exhaust openings with polyethylene sheeting and protect intakes to air handling units. Air handling units shall remain off.
8. Install all equipment needed for removal work in the containment area to minimize egress during demolition.
9. The Environmental Consultant will inspect the containment to verify that the containment is properly constructed and the containment area has an overall negative pressure of 0.02 to 0.04 inch water column relative to the outside and adjacent work areas not undergoing active remediation, prior to beginning demolition work.

B. Demolition:

1. Remove mold contaminated materials to be discarded, such as paper, and furniture. Double bag material in 6 mil poly bags. Seal poly bags

using duct tape inside the containment. HEPA vacuum bags before removing them from the containment or airlock. When possible, pass the bags directly from the containment or airlock to the outside. Transport bags to a dumpster. Do not leave the bags at the building / house.

2. Remove contaminated gypsum wallboard (GWB) at the preliminary limits of demolition specified in the Microbial Remediation Plan. Inspect back side of removed GWB. If mold is observed on the back side of the GWB, report this condition to the Environmental Consultant. Continue removing GWB until no mold is observed. If hidden mold is discovered that will extend past the extents of the containment, stop work immediately and reconstruct the containment to extend past the suspected contamination. Re-evaluate level of containment and PPE. Continue to operate AFUs during reconfiguring of containment.
3. Remove drywall by cutting in pieces as large as possible to minimize aerosolization of fungal spores. Drywall screws can either be backed out during removal or later during cleanup.
4. Use dust collection attachments on all power tools, such as sanders, saws, etc., to capture dust created when using the tools. Outlet of dust collector should discharge into inlet of AFU.
5. Remove fiberglass insulation behind removed gypsum board.
6. If wood studs are contaminated, scrub them with a brush and detergent to remove mold. Replace wood studs with damage severe enough to reduce the structural capacity of the member. Prior to removal of any structural member consult with the Architect.
7. Clean all metal framing with a dilute detergent solution. Clean metal framing with light rust using steel wool and coat with a rust inhibiting paint. Replace metal framing with rust damage severe enough to reduce the structural capacity of the member. Prior to removal of any structural material, consult with the Architect.
8. Remove contaminated carpet scheduled for removal.
9. Place removed gypsum board, insulation, carpet and remaining debris in two layers of 6 mil poly bags. Seal poly bags using duct tape inside the containment. HEPA vacuum bags before removing them from the containment or airlock. When possible pass the bags directly from the containment or airlock to the outside. Transport bags to a dumpster. Do not leave the bags at the building / house. Remediation workers shall HEPA vacuum their PPE, then remove them within the airlock chamber. Discard disposable coverall suits into a 6 mil poly bag.

C. Post-Demolition Inspection:

1. The Environmental Consultant will inspect the containment area to verify that all contaminated materials have been removed.

2. Allow a minimum of 12 hours after completion of removal work, with AFUs operating, for airborne dust in the containment to settle and / or be removed by the AFUs.

D. Cleaning after Demolition, and Cleaning of Settled Spores from Porous / Non-Porous Materials:

1. Continue to operate AFUs during cleaning.
2. Clean exposed surfaces.
 - a. HEPA vacuum all surfaces.
 - b. Damp wipe all non-porous exposed surfaces including polyethylene sheets used to protect materials, external surfaces of ductwork, studs, and floors with clean rag and clean potable water or detergent solution.
 - c. Remove poly sheeting inside the containment.
 - d. HEPA vacuum all surfaces protected by poly sheeting.
 - e. Damp wipe non-porous surfaces protected by poly sheeting with clean water or a detergent solution.
 - f. Clean carpet using procedures in Remediation of Fungally Contaminated Building Materials.
3. Final clearance inspection will be conducted by the DOT Environmental Consultant. Clearance inspections will be performed using the procedures detailed in Post-Remediation Inspection. Maintain containments in place until spaces are inspected and accepted by the DOT Environmental Consultant as being fully remediated. If final clearance does not pass, the Contractor shall conduct additional cleaning and repeat the clearance process.

3.05 FIRE PROTECTION: The Contractor shall provide portable fire extinguishers within the containment area and outside the decontamination unit. Fire extinguishers shall be rated for the class of fire hazards in the work area and shall be sized for coverage of the areas within the containment. At a minimum, one 10-pound ABC fire extinguisher for every 1,000 square feet shall be strategically placed around the containment. Personnel shall be trained for emergency egress and the use of fire extinguishers. Notify fire officials of work activities as required.

3.06 CONSTRUCTION BARRIERS

- A. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain. Shoring, bracing or support will be necessary when structural wood studs or metal framing need to be removed and replaced when they cannot be cleaned.
- B. Do not disturb microbial-contaminated building materials while isolating work areas. This precaution prevents the release of microbial spores.

- C. Workers shall wear respirators and other PPE as outlined in the microbial remediation plan when installing critical barriers where microbial contaminated surfaces (walls or surfaces with visible settled dusts) are likely to be disturbed. Operate an AFU if disturbance is likely during setup.
- D. Monitor the air pressure differential across work area containments. The monitoring system shall be in place before the start of remedial activities. Verification by the Industrial Hygienist is required prior to the start of the microbial remediation.

3.07 QUALITY ASSURANCE / QUALITY CONTROL REQUIREMENTS

- A. Contractor Qualifications: Work shall be performed by a qualified remediation contractor. Contractor shall carry insurance that specifically covers mold remediation.

Remediation contractor's on-site supervisor shall have one of the following certifications: Certified Mold Remediator (CMR), Certified Mold Remediation Supervisor (CMRS), or Applied Microbial Remediation Specialist (AMRS). Qualified supervisor shall be onsite whenever active remediation is being performed. Set-up activities may be performed without supervisor present; qualified supervisor shall review set-up prior to start of work.

Mold remediation workers shall be given training in PPE and mold remediation activities as required for their particular job. Microbial remediation plan shall provide details of worker training.

- B. Waste Management and Removal: Keep the site and work area free from accumulations of dust, waste materials, or rubbish caused by Contractor operations and free from any flammable materials or other sources of fire hazard. Remove all waste materials and rubbish from and about the work site in strict accordance with the specifications and applicable codes and regulations.

- C. Post-Remediation Inspection: Clean up all debris and dust in interior spaces outside the work area resulting from the Contractor's remediation work.

After all visible accumulations of material and debris are removed from the containment, provide the Environmental Consultant a 24-hour notice for a final clearance visual inspection. The Environmental Consultant shall conduct a thorough visual inspection of the work area. If during this inspection any visible debris and/or microbial contamination are observed, the Contractor shall re-clean the work area without additional cost.

- D. Clearance:

- 1. Clearance Criteria: Clearance will be based on visual assessment (all visible mold removed, all visible dust removed, based on a "white glove" test) by Environmental Consultant. "White glove" test shall consist of wiping the surface with a clean cloth of color suitable to reveal expected type of dust. For most surfaces, a white cloth is suitable. For GWB dust, a dark cloth may be more appropriate.
- 2. Failed remediation areas will be recleaned and the AFUs kept in operation another 12 hours, followed by another visual assessment. Subsequent failures will follow the same routine until a pass condition

is secured.

3.08 CLEAN-UP AND DISPOSAL

- A. Disposal of Material: Dispose of contaminated bagged waste materials removed during this remediation as general construction debris. Follow all applicable local, State, and Federal requirements for the disposal of this material.
- B. Material Packaging: Place waste, as waste is removed, into a disposal container promptly. Disposal containers shall consist of at a minimum, two layers of clear 6 mil polyethylene bags. Tape bags in a gooseneck fashion to form an airtight seal and label appropriately. Bag waste from vacuums equipped with HEPA filters in 6 mil polyethylene bags.
- C. Building Exit (Waste Disposal): HEPA vacuum and damp wipe bags of contaminated waste material prior to removal from the building.
- D. Hazardous Material: Should the Contractor encounter any hazardous materials, notify the Environmental Consultant and/or Architect immediately for direction.

END OF SECTION 02 8713

**SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK**

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Interior standing and running trim.
 - 2. Wood cabinets.
 - 3. Plastic-laminate countertops.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 06 10 00 - ROUGH CARPENTRY for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.

1.2 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.
 - 2. Manufacturers' product data for installation adhesives, including printed statement of VOC content.
 - 3. Composite wood manufacturer's product data for each composite wood product used indicating that the bonding agent contains no urea formaldehyde. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.
- 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.
 - 2. Show locations and sizes of cutouts and holes for plumbing fixtures, electrical components and other items installed in architectural woodwork.
 - 3. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- C. Samples for Verification:
 - 1. Lumber with or for transparent finish, not less than 5 inches wide by 12 inches long for each species and cut, finished on 1 side and 1 edge.
 - 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.

3. Lumber and panel products with shop-applied opaque finish, 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color, with 1/2 of exposed surface finished.
4. Plastic laminates, 8 by 10 inches for each type, color, pattern, and surface finish, with 1 sample applied to core material, and specified edge material applied to 1 edge.
5. Solid-surfacing materials, 6 inches square.

D. Qualification Data: For Installer and fabricator.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.4 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.
- B. Long Lead Items: Order long lead time materials with sufficient time to comply with manufacturers' delivery schedule, without causing delay to the construction schedule.

1.5 PROJECT CONDITIONS

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

1.6 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's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: See drawings.
- C. Wood Species for Opaque Finish (paint grade): Any closed-grain hardwood.
- D. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
 - 6. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 7. Wood Trim Profiles – as manufactured by Wood Techtonics – Greer SC.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include:

- a. FORMICA.
- b. WILSONART.
- c. Approved equal.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Section 08 71 00 - DOOR HARDWARE.
- B. Hinges: European style concealed self-closing type, BHMA No. A156.9,B01602, 135 degree, steel with polished finish.
- C. Back-Mounted Pulls: 4" Matte Stainless Steel Square Handle.
- D. Catches: Standard by manufacturer.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081] [BHMA A156.9, B04102; with shelf brackets, B04112.
- F. Drawer Slides:
 - 1. Static Load Capacity: Commercial grade.
 - 2. Mounting: side mounted.
 - 3. Stops: Integral type.
 - 4. Products: Knappe & Vogt Manufacturing Company, www.knappeandvogt.com

2.3 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. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.

2.4 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

- B. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR PAINT FINISH

- F. Grade: Custom.
- G. Wood Species and Cut: Match species and cut indicated for other types of paint-finished architectural woodwork located in same area of building, unless otherwise indicated.
 - 1. Provide split species on trim that faces areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.
- H. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- I. Assemble casings in plant except where limitations of access to place of installation require field assembly.

2.5 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Section 09900 - PAINTING for material and application requirements.
- D. 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.

- E. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523.
 - 1. Grade: Custom.
 - 2. AWI Finish System: Paint.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Sheen: Semi-gloss.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine stainless steel finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 - 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 - 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 - 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Trim cabinet bases to achieve handicap accessible height as noted on the drawings.
- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 3. Secure sidesplashes to tops with concealed metal brackets at 16 inches and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Section 07920 - JOINT SEALANTS.
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 06 4100

**SECTION 07 8413
PENETRATION FIRESTOPPING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data:** Penetration firestopping systems.

- B. Product Schedule:** For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Listed System Designs:** For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates:** From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Installation Responsibility: Assign installation of penetration firestopping systems and joint firestopping in Project to a single qualified installer.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain penetration firestop systems for each type of opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test in accordance with testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with listed system designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."
 - 3) FM Approvals in its "Approval Guide."

2.3 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Hilti, Inc.
 - d. Specified Technologies Inc.
 - e. Tremco Incorporated.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479.
 - 1. F-Rating: Not less than the fire-resistance rating of the wall penetrated.
- C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement,

fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.
- K. Fire-Rated Cable Sleeve Kits: Complete kits designed for new or existing cable penetrations through walls to accept standard accessories.
- L. Firestop Plugs: Flexible, re-enterable, intumescent, foam-rubber plug for use in blank round openings and cable sleeves.

2.5 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with 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 penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage

and migration onto exposed surfaces.

3.3 INSTALLATION OF PENETRATION FIRESTOPPING SYSTEMS

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming 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.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 8413

**SECTION 07 8443
JOINT FIRESTOPPING**

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, smoke barriers, and for wall identification.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference:** Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Joints in or between fire-resistance-rated construction.

- B. Product Schedule:** For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly developed in accordance with current International Firestop Council (IFC) guidelines.

1.4 INFORMATIONAL SUBMITTALS

- A. Listed System Designs:** For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates:** From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:** A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with

UL's "Qualified Firestop Contractor Program Requirements."

- B. Installation Responsibility: Assign installation of penetration firestopping systems and joint firestopping in Project to a single qualified installer.

1.7 PROJECT CONDITIONS

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

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.
 - 1) UL in its online directory "Product iQ."
 - 2) Intertek Group in its "Directory of Building Products."

2.3 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
 2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
 3. Provide firestop products that do not contain ethylene glycol.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products.
 - b. A/D Fire Protection Systems Inc.
 - c. Hilti, Inc.
 - d. Specified Technologies, Inc.
 - e. Tremco Incorporated.
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
1. Verify sealant has a VOC content of 250 g/L or less.

2.4 ACCESSORIES

- A. Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately 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 elastomeric fill materials or compromise fire-resistive rating.
 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum

- bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
- 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint 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. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition occurs, such as the intersection of a gypsum wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

3.3 INSTALLATION

- A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
- B. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 CLEANING AND PROTECTION

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

3.6 JOINT FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.
- B. Head-of-Wall, Joint Firestopping Systems:
 1. UL-Classified Systems: HW-D- 0000-0999.
 2. Assembly Rating: 2 hours.
 3. Nominal Joint Width: As indicated.

END OF SECTION 07 8443

SECTION 07 9005
JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealants and joint backing.
- B. Precompressed foam sealers.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.

1.03 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other sections referencing this section.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.08 COORDINATION

- A. Coordinate the work with all sections referencing this section.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Silicone Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Polyurethane Sealants:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Pecora Corporation: www.pecora.com.

3. BASF Construction Chemicals-Building Systems: www.chemrex.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Acrylic Sealants:
 1. Tremco Global Sealants: www.tremcosealants.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Butyl Sealants:
 1. Bostik Inc: www.bostik-us.com.
 2. Pecora Corporation: www.pecora.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Acrylic Emulsion Latex Sealants:
 1. Bostik Inc: www.bostik-us.com.
 2. Pecora Corporation: www.pecora.com.
 3. BASF Construction Chemicals-Building Systems: www.chemrex.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Preformed Compressible Foam Sealers:
 1. EMSEAL Joint Systems, Ltd: www.emseal.com.
 2. Sandell Manufacturing Company, Inc: www.sandellmfg.com.
 3. Dayton Superior Corporation: www.daytonsuperior.com.

2.02 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 1. Color: Standard colors matching finished surfaces.
 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- B. Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
 1. Applications: Use for:
 - a. Concealed sealant bead in sheet metal work.
 - b. Concealed sealant bead in siding overlaps.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 1. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
- D. Plumbing fixture/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.
- E. Acoustical Sealant for Concealed Locations:
 1. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

2.03 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces and joint openings are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 - 1. Width/depth ratio of 2:1.
 - 2. Neck dimension no greater than 1/3 of the joint width.
 - 3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker where joint backing is not used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- G. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- H. Tool joints concave.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

END OF SECTION 07 9005

**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated frames.
- B. Steel frames for wood doors.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 09 9123 – Interior Painting.

1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- D. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Frames:
 - 1. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMES

- A. Requirements for All Frames:
 - 1. Accessibility: Comply with ANSI/ICC A117.1.
 - 2. Finish: Factory primed, for field finishing.
 - 3. Corners: Mitered, factory welded.

2.03 STEEL FRAMES

- A. General:
 - 1. Comply with the requirements of grade specified for corresponding door.

- a. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
- 2. Finish: Factory primed, for field finishing.
- 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- 4. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- 5. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top. Fully welded type.
- B. Interior Door Frames, Non-Fire-Rated: Fully welded type.
 - 1. Finish: Factory primed, for field finishing.
- C. Frames for Interior Glazing or Borrowed Lights: Construction and face dimensions to match door frames, and as indicated on drawings.

2.04 ACCESSORY MATERIALS

- A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- B. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.05 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
- C. Finish to match existing frames.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- D. Coordinate installation of hardware.
- E. Coordinate installation of glazing.
- F. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION 08 1113

**SECTION 08 1407
COMMERCIAL WOOD DOORS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior standard wood veneer flush wood doors.
- B. Related Requirements:
 - 1. Section 08 11 13: Hollow metal frames for wood doors.
 - 2. Section 08 71 00: Door hardware.

1.2 PREINSTALLATION MEETINGS

- A. Conduct pre-installation meeting at Project site.
- B. Discussion Topics:
 - 1. Delivery, storage, and handling.
 - 2. Coordination with hardware and access control installers.
 - 3. Protection of installed doors.

1.3 ACTION SUBMITTALS

- A. Product Data: Each type of door and finish.
 - 1. Core and edge construction.
 - 2. Fire rated doors.
 - 3. Glazed openings.
 - 4. Louvers.
 - 5. Finishes.
- B. Shop Drawings and Schedule:
 - 1. Use same unit designations used in Contract Documents.
 - 2. Hardware preparation.
 - 3. Glazed openings.
 - 4. Louvers.
- C. Samples for Selection:
 - 1. Available standard stain colors and gloss options.
 - 2. Available standard molding profiles for glazed openings.
- D. Samples for Verification:
 - 1. Transparent Finish Doors: Each required veneer species and factory finish; minimum 8 by 10 inches [200 by 250 mm] corner unit showing construction and finish.
 - 2. Light Opening Moldings: Minimum 6 inches [150 mm] long, for each material, type, and finish required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Manufacturer warranties transferrable to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package factory-finished doors individually in manufacturer's standard plastic bags, stretch wrap, or cardboard cartons.
- B. Store doors inside building in clean, dry location.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity at occupancy levels during remainder of construction period.

1.7 EXISTING DOORS

- A. Existing doors indicated to remain shall be protected during construction.
- B. Existing doors removed to facilitate construction shall be carefully removed, stored, and reinstalled.
- C. Notify Architect of damaged, deteriorated, or non-functional doors prior to replacement.
- D. Replacement of existing doors in historic areas shall not occur without Architect approval.

1.8 MANUFACTURER WARRANTIES

- A. Standard manufacturer warranties.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6 mm) in 42-by-84-inch (1065-by-2130-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in 3-inch (0.25 mm in 76-mm) span.
 - 2. Solid Core Doors: Limited lifetime warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Products of Cendura™ Series | Mohawk by Masonite Architectural are specified to indicate requirements for quality and appearance.
 - 1. Website: [Masonite.com/architectural/products/cendura-series](https://www.masonite.com/architectural/products/cendura-series)
 - 2. Phone: 877.332.4484
- B. Subject to compliance with requirements, substitutions are permitted.
- C. Source Control: Supply all wood doors from a single manufacturer.

2.2 MANUFACTURING STANDARD

- A. Interior Wood Doors: Window & Door Manufacturers Association publication ANSI/WDMA I.S. 1A "Industry Standard for Interior Architectural Wood Flush Doors".
 - 1. Blocking: Provide composite blocking approved for use in doors of fire-protection ratings indicated as needed to maintain WDMA performance level and eliminate through-bolting hardware.
 - 2. Existing historic doors indicated to remain shall be protected during construction.
 - 3. Where replacement doors are required in historic areas, provide doors compatible with the appearance, construction, and character of existing adjacent historic doors. Submit shop drawings and product data for Architect review.

2.3 INTERIOR SOLID CORE STANDARD VENEER FLUSH WOOD DOORS FOR TRANSPARENT FINISH

- A. Basis of Design: Cendura™ Series | Mohawk by Masonite Architectural

- B. Solid Core Standard Veneer Flush Wood Doors:
 - 1. WDMA Quality Standard: Custom.
 - 2. WDMA Performance Level: Heavy Duty.
 - 3. Faces:
 - a. Veneer Grade: A.
 - b. Veneer Species: Match existing adjacent historic doors where applicable. Architect to approve selection.
 - c. Veneer Cut: Rotary
 - d. Veneer Leaf Match: Book match.
 - e. Veneer Face Match: Running match.
 - 4. Pair Match: Provide for doors hung in same opening or separated only by mullions.
 - 5. Vertical Edges: Mill option softwood or low-density hardwood.
 - 6. Horizontal Edges: Structural composite lumber.
 - 7. Core: Structural composite lumber.
 - 8. Construction: Five plies. Stiles and rails are bonded to core, and then entire unit is abrasive planed before veneering.
 - 9. Thickness: **1-3/4 inch.**
- C. Solid Core Standard Veneer Flush Wood Doors with Glazed Lites:
 - 1. Match appearance grade and applicable construction and performance requirements of other standard veneer flush solid core wood doors.
 - 2. Factory Glazing: Refer to Section 08 80 00 "Glazing" for glass view panels in flush wood doors. Fill glazing bead nail holes in factory finished doors.
 - 3. Wood Glazing Accessories: Solid wood of same species as face veneer in standard profile selected by Architect.
 - a. Bead Profile: Straight Lip.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that door frames are plumb, square, and accurate size.
- B. Inspect each door before installation for damage and defects per WDMA Section F-6.

3.2 INSTALLATION

- A. Hardware installation is specified in Section 08 7100 – Door Hardware.
- B. Reference Standards:
 - 1. Wood Doors: WDMA I.S. 1A.
 - 2. Fire-Rated Doors: NFPA 80.
 - 3. Smoke-and Draft-Control Doors: NFPA 105.
- C. Align doors with uniform vertical and top edge clearance.

3.3 REPAIR

- A. Repair of damage or defects is subject to Architect's acceptance, including removal of soiling.
- B. Provide new replacement doors for doors that cannot be satisfactorily repaired.

3.4 PROTECTING AND CLEANING

- A. Protect installed doors from damage and soiling.
- B. Clean doors shortly before inspection for Substantial Completion.

END OF SECTION 08 1407

**SECTION 08 3100
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

PART 2 PRODUCTS

2.01 ACCESS DOOR AND PANEL APPLICATIONS

- A. Walls, Unless Otherwise Indicated:
 - 1. Material: Stainless Steel.
 - 2. Size: 18 by 18 inch, unless otherwise indicated.
 - 3. Standard duty, hinged door.
 - 4. Key-operated spring or cam lock; no handle.
 - 5. Insulated.
 - 6. In Masonry: Surface mounted frame with door surface flush with frame surface.

2.02 WALL AND CEILING UNITS

- A. Manufacturers:
 - 1. ACUDOR Products Inc: www.acudor.com.
- B. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
 - 1. Door Style: Single thickness with rolled or turned in edges.
 - 2. Steel Finish: Primed.
 - 3. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's custom colors or primed and painted custom color.
 - 4. Hardware:
 - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - b. Latch/Lock: Cylinder lock operated cam latch, two keys for each unit.

END OF SECTION 08 3100

**SECTION 08 7100
DOOR HARDWARE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for interior wood and exterior wood and metal doors.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 – Hollow Metal Doors and Frames.

1.03 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. BHMA A156.2 - American National Standard for Bored and Preassembled Locks & Latches; Builders Hardware Manufacturers Association; 2011 (ANSI/BHMA A156.2).
- C. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc.; 2008 (ANSI/BHMA A156.4).
- D. BHMA A156.6 - American National Standard for Architectural Door Trim; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.6).
- E. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; 2010 (ANSI/BHMA A156.8).
- F. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc.; 2006 (ANSI/BHMA A156.18).
- G. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association; 2012 (ANSI/BHMA A156.22).
- H. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; Door and Hardware Institute; 1993; also in WDHS-1/WDHS-5 Series, 1996.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
- C. Samples: Prior to preparation of hardware schedule:
 - 1. Submit 1 sample of hinge and passage closer illustrating style, color, and finish.
 - 2. Samples will not be returned to supplier.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 10 years of experience.
- C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS - BASIS OF DESIGN

- A. ASSA ABLOY Accentra GT/Corbin Russwin 152/Sargent GT Lever.

2.02 DOOR HARDWARE - GENERAL

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide all items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
 - 3. Applicable provisions of NFPA 101, Life Safety Code.
- D. Function: Lock and latch function descriptions of manufactures series as listed in hardware schedule.
- E. Finishes: All door hardware the same finish unless otherwise indicated.
 - 1. Primary Finish: Refer to Hardware Schedule on the drawings.
- F. Historic Areas: Existing hardware designated by the Architect shall remain and be protected during construction. Where new or replacement hardware is required in historic areas, provide products compatible with the character of the existing building. Match existing hardware in general style, finish, and appearance to the greatest extent practical. Submit proposed hardware schedule and product data for Architect review prior to procurement.

2.03 HINGES

- A. Hinges: Provide hinges on every swinging door.
 - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated, three hinges per door.
 - 2. Provide ball-bearing hinges at all doors.
 - 3. Provide hinges in the quantities indicated.
- B. Manufacturers - Hinges:
 - 1. Assa Abloy McKinney: www.assaabloydss.com.

2.05 LOCKS AND LATCHES

- A. Locks: As indicated in the Hardware Schedule.
 - 1. Hardware Sets indicate locking functions required for each door.
 - 2. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim. Refer to Hardware Schedule.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
 - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
 - 1. Include construction keying.
 - 2. Supply keys in the following quantities:
 - a. 5 master keys.
 - b. 5 grand master keys.
 - c. 2 construction keys.
 - d. 2 control keys and 2 extra cylinder cores.
 - e. 2 change keys for each lock.
- D. Occupancy Indicator: Model #460 Assa Abloy

2.09 STOPS AND HOLDERS

- A. Stops: As noted in the Hardware Schedule.

2.10 GASKETING AND THRESHOLDS

- A. Gasketing and Thresholds: As noted on the Hardware Schedule.

2.11 PROTECTION PLATES AND ARCHITECTURAL TRIM

- A. Protection Plates:
 - 1. Kickplate: As noted in the Hardware Schedule.

2.12 KEY CONTROLS

- A. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
- B. Fire Department Lock Box: This item shall be specified by the fire department having local jurisdiction. The contractor shall coordinate the order, delivery and shall install item in a designated location. Contractor shall provide payment for item, including tax and freight, and installation.

2.13 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS

- A. Provide products that comply with the following:
 - 1. Applicable provisions of Federal, State, and local codes.
 - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
 - 3. Applicable provisions of NFPA 101, Life Safety Code.
- B. Finishes: Identified in schedule on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.

- C. Mounting heights for hardware from finished floor to center line of hardware item:
 - 1. For wood doors: Comply with DHI "Recommended Locations for Architectural Hardware for Wood Flush Doors."

3.03 FIELD QUALITY CONTROL

- A. Provide an Architectural Hardware Consultant to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00.
- B. Adjust hardware for smooth operation.

3.05 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

- A. Protect finished Work under provisions of Section 01 70 00.
- B. Do not permit adjacent work to damage hardware or finish.

3.07 SCHEDULE - REFER TO DRAWINGS.

END OF SECTION 08 7100

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Wood stud wall framing.
- C. Wood ceiling framing.
- D. Insulation.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Acoustic sealant.

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2002 (Reapproved 2007).
- B. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2011.
- C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2007.
- D. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2010a.
- E. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; 2008b.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2011.
- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- H. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2010.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on gypsum board, accessories, and joint finishing system.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

2.02 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - 3. National Gypsum Company: www.nationalgypsum.com.
 - 4. USG Corporation: www.usg.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard below 4 feet AFF: Basis of Design - GOLD BOND, HI-IMPACT XP Gypsum Board as manufactured by National Gypsum. Sizes to minimize joints in place; ends square cut.
 - 1. Regular Type:
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.
- C. Gypsum Wallboard above 4 feet AFF: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; tapered edges, ends square cut.
 - 1. Application: Use for vertical surfaces above 4 feet AFF, unless otherwise indicated.
 - 2. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - 3. Mold-Resistant Paper-Faced Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Georgia-Pacific Gypsum; ToughRock Mold-Guard and ToughRock Mold-Guard Type X Gypsum Wallboard.
 - c. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - d. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Backing Board For Wet Areas: One of the following products:
 - 1. Application: Surfaces behind tile in wet areas including - as indicated on the drawings.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 1/2 inch.
 - b. Products:
 - 1) National Gypsum Company; PermaBase Brand Cement Board.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.
- F. Gypsum Wallboard Fire Rated: Basis of Design: Gold Bond Type e² XP and Fire Shield as manufactured by National Gypsum to meet the requirements of the UL Assembly indicated on the drawings. Sizes to minimize joints in place; ends square cut.

1. Regular Type:
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.

2.03 ACCESSORIES

- A. Finishing Accessories: ASTM C1047, galvanized steel, unless otherwise indicated.
 1. Types: As detailed or required for finished appearance.
- B. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners.
 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 3. Ready-mixed vinyl-based joint compound.
- C. Screws: ASTM C 1002; self-piercing tapping type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Wood Framing: Install in accordance with manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as permitted by standard.
 1. Level ceiling system to a tolerance of 1/1200.
 2. Laterally brace entire suspension system.
- C. Studs: Space studs as permitted by standard.
- D. Blocking: Install wood blocking for support of:
 1. Framed openings.
 2. Wall mounted cabinets.
 3. Toilet accessories.
 4. Wall mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.05 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum $\frac{1}{32}$ inch.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: $\frac{1}{8}$ inch in 10 feet in any direction.

END OF SECTION 09 2116

SECTION 09 5100
SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Supplementary acoustical insulation above ceiling.

1.02 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; Current Edition.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; Current Edition.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; Current Edition.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples size illustrating material and finish of acoustical units.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Provide 100 sq ft of each type of acoustical unit for Owner's use in maintenance of project.

1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. BASIS OF DESIGN: Armstrong World Industries, Inc: www.armstrong.com
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. USG: www.usg.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Acoustical Units - General: ASTM E1264, Class A.

- C. Acoustical Tile: 24" x 24" to match existing.

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. Same as for acoustical units.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
 - 1. Profile: 15/16".
 - 2. Finish: White painted.

2.03 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Acoustical Insulation:
 - 1. Thickness: 6" inch.
 - 2. Size: To fit acoustical suspension system.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.

2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 1. Make field cut edges of same profile as factory edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION 09 5100

**SECTION 09 9113
EXTERIOR PAINTING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel and iron.
 - 2. Galvanized metal.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.

4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY CONTROL

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Owner or Owner's Representative will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Owner or Owner's Representative will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Owner or Owner's Representative at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner or Owner's Representative specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures

are between 50 and 95 deg F (10 and 35 deg C).

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints.
 - 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Owner or Owner's Representative from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.
- B. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Testing agency will perform tests for compliance with product requirements.
 - 2. Owner or Owner's Representative may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for

testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.

- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and

inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.

- B. Dry Film Thickness Testing: Contractor shall engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Steel and Iron Substrates:
 - 1. Alkyd System MPI EXT 5.1D:
 - a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
 - 1) Sherwin Williams; (Protective and Marine) Steel Spec Universal Metal Primer: B50WV8430.
 - b. Intermediate Coat: Exterior, alkyd enamel, matching topcoat.

- c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.
 - 1) Sherwin Williams; (Protective and Marine) DMT Alkyd Semi-Gloss: B55W00101.
- B. Galvanized-Metal Substrates:
 - 1. Latex System MPI EXT 5.3H:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - 1) Sherwin Williams; (Pro Industrial) Pro-Cryl Universal Primer: B66W310.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.
 - Sherwin Williams; (A-100) Exterior latex
 - Gloss: A08W00151/A08WQ0151.

END OF SECTION 09 9113

**SECTION 09 9123
INTERIOR PAINTING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete masonry units (CMUs).
 - 2. Steel and iron.
 - 3. Galvanized metal.
 - 4. Gypsum board.
- B. Related Requirements:
 - 1. See structural drawings for shop priming structural steel.
 - 2. See structural drawings for shop priming metal fabrications.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY CONTROL

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Owner will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9sq. m).
 - b. Other Items: Owner will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Owner at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Benjamin Moore & Co.
 2. PPG Paints.
 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Owner or Owner's Representative from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Contractor will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner or Owner's Representative may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply

tie coat as required to produce paint systems indicated.

- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer,, but not less than the following:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas whereshop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharplines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.

- c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
- 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Owner.
- 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. The Contractor shall be responsible for all required Quality Control testing and inspection. All work is subject to additional specialty inspections and Quality Assurance testing and inspection by the Owner or Owner's Representative. Contractor shall cooperate and provide access to all materials and work and provide additional samples to the Owner's Representative upon request. All work found by the Owner's Representative not to be in conformance with these specifications must be satisfactorily remedied by the Contractor, at no additional cost to the Owner, as a condition to acceptance of the work.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Owner, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

- 1. High-Performance Architectural Latex System MPI INT 4.2D:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - 1) Sherwin Williams; (Pro Industrial) Heavy Duty Block Filler: B42W00150.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI GlossLevel 3), MPI #139.
 - 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-Shel: B20W01951.

B. Steel Substrates:

- 1. High-Performance Architectural Latex System MPI INT 5.1R:
 - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
 - 1) Sherwin Williams; (Protective & Marine) Kem Bond HS Universal Alkyd Primer: B50WZ0004.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural (MPI GlossLevel 3), MPI #139.
 - 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-Shel: B20W01951.

C. Galvanized-Metal Substrates:

- 1. High-Performance Architectural Latex System MPI INT 5.3M:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - 1) Sherwin Williams; (Protective & Marine) DTM Acrylic Primer/Finish: B66W1.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-

gloss(MPI Gloss Level 5), MPI #141.

- 1) Sherwin Williams; (Pro Industrial) Acrylic Semi-Gloss Coating:
B66W00651.

D. Gypsum Board Substrates:

1. High-Performance Architectural Latex System MPI INT 9.2B:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.

- 1) Sherwin Williams; (ProMar 200 Zero) Interior Latex
Primer: B28W02600/BW8WQ2600.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching
topcoat.

- c. Topcoat: Latex, interior, high performance architectural (MPI
GlossLevel 3), MPI #139.

- 1) Sherwin Williams; (ProMar 200 HP Zero VOC) Interior Acrylic Eg-
Shel: B20W01951.

END OF SECTION 09 9123

**SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Above ground piping.
- B. Escutcheons.
- C. Mechanical couplings.
- D. Pipe hangers and supports.
- E. Pipe sleeves.
- F. Pipe sleeve-seal systems.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- D. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.03 REFERENCE STANDARDS

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- D. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings; 2024.
- E. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded; 2021.
- F. ASME B16.25 - Buttwelding Ends; 2022.
- G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- I. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- K. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- L. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- M. AWWA C606 - Grooved and Shouldered Joints; 2022.
- N. FM (AG) - FM Approval Guide; Current Edition.
- O. FM 1920 - Approval Standard for Pipe Couplings and Fittings for Aboveground Fire Protection Systems; 2007.
- P. ITS (DIR) - Directory of Listed Products; Current Edition.
- Q. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- R. UL (DIR) - Online Certifications Directory; Current Edition.
- S. UL 213 - Rubber Gasketed Fittings for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Manufacturer's qualification statement.
- E. Project Record Documents: Record actual locations of components and tag numbering.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Minimum three years experience.
- C. Valves: Bear FM (AG), UL (DIR), and ITS (DIR) or Warnock Hersey product listing label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- E. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Division 01, Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Sprinkler-based System:
 - 1. Comply with NFPA 13.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

2.02 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A135/A135M Schedule 10 or ASTM A795 Schedule 40, black.
 - 1. Steel Fittings: ASME B16.5 steel flanges and fittings.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
 - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.03 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.

2.04 PIPE SLEEVE-SEAL SYSTEMS

- A. Modular Mechanical Seals:
 - 1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
- B. Wall Sleeve: Steel material with waterstop collar, and nailer end caps.

2.05 ESCUTCHEONS

- A. Material:
 - 1. Chrome-plated.
 - 2. Metals and Finish: Comply with ASME A112.18.1.
- B. Construction:
 - 1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
 - 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.06 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Vertical Support: Steel riser clamp.

2.07 MECHANICAL COUPLINGS

- A. Rigid Mechanical Couplings for Grooved Joints:
 - 1. Dimensions and Testing: Comply with AWWA C606.
 - 2. Minimum Working Pressure: 300 psig.
 - 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
 - 4. Housing Coating: Factory applied orange enamel.
 - 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
 - 6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

2.08 PRESSURE GAUGES

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.

- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 - 1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 2. Place hangers within 12 inches of each horizontal elbow.
 - 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- H. Structural Considerations:
 - 1. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating walls and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 2. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
- J. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a watertight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- K. Escutcheons:
 - 1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
 - 2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
 - 3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- L. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. See Division 01, Construction Waste Management and Disposal for additional requirements.

END OF SECTION 21 0500

SECTION 21 0553
IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.04 SUBMITTALS

- A. Refer to Division 1 for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for fire suppression identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.
- F. Project Record Documents: Record actual locations of tagged valves.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Piping: Tags.
- B. Valves: Tags and ceiling tacks where above lay-in ceilings.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic, multilayer, multicolor, plastic labels for mechanical engraved letters, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 1. Letter Color: White.
 - 2. Background Color: Black.
 - 3. Thickness: 1/8 inch.
 - 4. Plastic: Comply with ASTM D709.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless steel rivets or screws.

2.03 TAGS

- A. Valve Tags: 1-1/2" diameter minimum, stamped or engraved with 1/4 inch letters for piping-system abbreviation and 1/2 inch numbers.
 - 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
 - 2. Fasteners: Brass or stainless steel beaded chain or S-hook.
 - 3. Valve-Tag Color: Red.
 - 4. Letter Color: White.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

2.04 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: brass grommet and brass or stainless steel wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", or "DO NOT OPERATE"
 - 4. Color: Yellow background with black lettering.

2.05 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating identification of system type and fluid being conveyed.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each piece of equipment.
- D. Locate labels where accessible and visible.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finish spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection excluding short take-offs. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.03 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping system. List tagged valves in a valve-tag schedule.
- B. Valve-tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-tag Size and Shape" Subparagraph below:
 - 1. Valve-tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

3.04 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.05 CLOSEOUT ACTIVITIES

- A. Refer to Division 1: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

END OF SECTION 21 0553

**SECTION 21 1300
FIRE-SUPPRESSION SPRINKLER SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

1.03 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; 2022.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- D. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- E. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- F. AWWA C606 - Grooved and Shouldered Joints; 2022.
- G. FM (AG) - FM Approval Guide; Current Edition.
- H. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.
- B. Design: For sprinkler systems indicated to comply with performance requirements and design criteria, including drawings and hydraulic calculations signed and sealed by NICET Level 3 qualified professional who is responsible for their preparation.
 - 1. The design professional shall obtain current water flow test (within 12 months of design submittal) indicating available flow and pressures from existing city water supply.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: Shall be a minimum of 10 percent or as required by state and local AHJ, including losses through water-service piping, valves, and backflow preventers, whichever requirement is more stringent.
 - 2. Sprinkler Occupancy Hazard Classifications: As indicated within the contract drawings.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design: All areas requiring fire sprinkler protection shall be designed to minimum requirements set forth in NFPA, as indicated within the contract drawings or per state and local AHJ, whichever is more stringent.

1.05 SUBMITTALS

- A. Refer to Division 01 for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, hangers, pipe, fittings and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

- C. Shop Drawings:
 - 1. Include hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, details components, and accessories. Indicate system controls. Indicate all required elements as outlined by NFPA-13 "Shop Drawings"
 - 2. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Engineer/Architect.
 - 3. Submit shop drawings, hydraulic calculations and product data to engineer for approval.
- D. Grooved joint couplings and fittings shall be shown on shop drawings and product submittals and shall be specifically identified with the applicable manufacturer, style and model number.
- E. Sprinkler heads shall be referred to on drawings, submittal and other documentation, by the sprinkler identification number (SIN) and model number as specifically published in the appropriate agency listing or approvals. Trade names or other abbreviated designations shall not be allowed.
- F. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer or designer responsible for their preparation.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- I. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service vendor.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Refer to Division 01 for additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: For each sprinkler type.
- K. Qualification data: For qualified installer and NICET Level 3 certificate holder.
- L. Welding certificates.
- M. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.06 COORDINATION

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Items penetrating finished ceiling include, but not limited to the following:
 - a. Lighting fixtures.
 - b. Fire alarm speakers

1.07 EXTRA MATERIALS

- A. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
- B. Furnish extra materials that match products installed and that are packaged with protective coverings for storage and identified with I
 - 1. Refer to Division 01 for additional provisions.
 - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
 - 3. Sprinkler Wrenches: For each sprinkler type.

4. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA-13 and sprinkler wrenches. Provide larger or additional cabinets when sprinkler head quantities dictate.

1.08 QUALITY ASSURANCE

- A. Qualifications:
 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing NICET Level 3 minimum design services needed to assume design responsibility.
 - a. Designer Responsibility: Preparation of working plans (shop drawings), calculations, and field test reports by a qualified NICET Level 3 professional.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience and approved by manufacturer.
- D. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- E. Products, Components, Devices and Accessories Requiring Electrical Connection: Listed and classified by UL (DIR) and NFPA-70 as suitable for the purpose specified and indicated.
- F. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation and testing shall be in compliance with the standards listed within the contract drawings.
- G. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure vessel Code.
- H. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer or compatible with the grooved components supplied.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 1. Manufacturer and model as noted within the contract drawings.

2.02 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for entire building, or as indicated within the contract drawings.
- B. Occupancy: Shall comply with NFPA and as indicated within the contract drawings, most stringent shall be utilized.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Storage Cabinet for Spare Sprinklers and Tools: Steel, locate adjacent to system riser.
- E. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Other Types: As required.
 4. Hangers shall be installed per NFPA, manufacturers listing and requirements, coordinated with structure and structural engineer.

2.03 SPRINKLERS

- 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. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Tyco Fire & Building Products LP.
 - 4. Victaulic Company.
 - 5. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig Minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. Characteristics: Nominal orifice with Discharge Coefficient for "Ordinary" temperature classification rating unless otherwise indicated, required by application or NFPA.
- D. Sprinkler Finishes:
 - 1. Provide as indicated within the contract drawings.
- E. Sprinkler Guards:
 - 1. Provide where shown on the contract drawings.
 - 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.
 - 4. Head guard shall be listed to be used with installed sprinkler head.
- F. Exposed Area Type: Upright type with guard.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA-13 and NFPA-291. Use results for required system design calculations.
- B. Official documentation witnessed by local AHJ shall be provided with shop drawing submittal.

3.02 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.3
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect/Engineer before deviating from approved working plans.
- C. Install equipment in accordance with manufacturer's instructions.
- D. When required, Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- E. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- F. Place pipe runs to minimize obstruction to other work.
- G. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

- H. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and Section 210553 - Identification for Fire Suppression Piping and Equipment.
- N. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- O. Flush entire piping system of foreign matter.
- P. Hydrostatically test entire system.

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.04 CLOSEOUT ACTIVITIES

- A. Refer to Division 01: Project record documents, operation and maintenance (O&M) data, warranties and bonds.

END OF SECTION 21 1300

**SECTION 23 0130.51
HVAC AIR-DISTRIBUTION SYSTEM CLEANING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of HVAC duct system, equipment, and related components.

1.02 RELATED REQUIREMENTS

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

1.03 DEFINITIONS

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

1.04 REFERENCE STANDARDS

- A. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 TOOLS AND EQUIPMENT

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

2.02 REPLACEMENT PRODUCTS

- A. Fibrous Glass Insulation: Provide material complying with UL 181 equivalent to existing material in quality and thickness.

2.03 SURFACE TREATMENTS

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

- A. Comply with applicable federal, state, and local requirements.
- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Obtain Owner's approval of proposed temporary locations for large equipment.
- E. Designate a decontamination area and obtain Owner's approval.

- F. If unforeseen mold or other biological contamination is encountered, notify Engineer/Architect immediately, identifying areas affected and extent and type of contamination.

3.02 EXAMINATION

- A. Inspect the system as required to determine appropriate methods, tools, equipment, and protection.
- B. Start of cleaning work constitutes acceptance of existing conditions.
- C. When concealed spaces are later made accessible, examine and document interior conditions prior to beginning cleaning.
- D. Document all instances of mold growth, rodent droppings, other biological hazards, and damaged system components.

3.03 PREPARATION

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
 - 1. Do not cut openings in non-HVAC components without obtaining the prior approval of Owner.
 - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
 - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

3.04 CLEANING

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

3.05 REPAIR

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.
- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

3.06 FIELD QUALITY CONTROL

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Engineer/Architect when cleaned components are ready for inspection.
- E. When directed, re-clean components until they pass.
- F. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

3.07 ADJUSTING

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

3.08 WASTE MANAGEMENT

- A. Double-bag waste and debris in 6 mil, 0.006 inch thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

END OF SECTION 23 0130.51

**SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Section 26 2913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.
- C. NEMA MG 00001 - Motors and Generators; 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to drawings for motor voltage and phase requirements.
- B. Nominal Efficiency: All motors shall comply with the minimum energy efficiency requirements of the Department of Energy.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 00001 limits for insulation class, service factor, and motor enclosure type.
 - 4. Motors with frame sizes 254T and larger: Energy efficient type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.02 APPLICATIONS

- A. Motors located in exterior locations, air cooled condensers, and direct drive axial fans: Totally enclosed type.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.06 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Comply with NEMA MG 00001 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours.

Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

- J. Sound Power Levels: To NEMA MG 00001.
- K. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION 23 0513

**SECTION 23 0516
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 2113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2024.
- B. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- C. EJMA (STDS) - EJMA Standards; Eleventh Edition.
- D. FM (AG) - FM Approval Guide; Current Edition.
- E. ITS (DIR) - Directory of Listed Products; Current Edition.
- F. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Design Data: Indicate selection calculations.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- E. Maintenance Data: Include adjustment instructions.
- F. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Division 01, Product Requirements for additional provisions.
 - 2. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Flex-Weld, Inc; ____: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company; ____: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company; ____: www.metraflex.com/#sle.
 - 4. Unisource Manufacturing, Inc; Series 401, Stainless Steel Threaded Connectors: www.unisource-mfg.com/#sle.
 - 5. Substitutions: Division 01, Product Requirements.
- B. Inner Hose: Bronze.

- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi up to 12 inch.
- E. Maximum Service Temperature: 450 degrees F.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
 - 1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company; _____: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc; Series 411, Bronze Braided Flex Connectors: www.unisource-mfg.com/#sle.
 - 4. Substitutions: Division 01, Product Requirements.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch.
- E. Maximum Service Temperature: 450 degrees F.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

2.03 EXPANSION JOINTS - METAL BELLOWS TYPE

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex 308/311 Series: www.kelcoind.com/#sle.
 - 2. Flexicraft; https://www.flexicraft.com/Metal_Expansion_Joints
 - 3. Uniflex; <https://www.uniflexinc.com/>
 - 4. The Metraflex Company; [_____]: www.metraflex.com/#sle.
 - 5. Substitutions: Division 01, Product Requirements.
- B. Provide shroud to protect from external damage and allows for the application of external insulation.
- C. Provide with tie rods to prevent over-compression or over-elongation.
- D. Pressure Rating: 125 psi and 400 degrees F.
- E. Maximum Compression: 1-3/4 inches.
- F. Maximum Extension: 1/4 inch.
- G. Size: Use pipe sized units.
- H. Application: Steel piping 2 inches and larger.

2.04 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Flex-Weld, Inc; Keflex 7Q Series - Quadra-Side: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company; _____: www.metraflex.com/#sle.
 - 4. Flexicraft; https://www.flexicraft.com/Metal_Expansion_Joints
 - 5. Substitutions: Division 01, Product Requirements.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 1-3/4 inches.
- D. Maximum Extension: 1/4 inch.

- E. Size: Use pipe sized units.
- F. Application: Steel piping 3 inches and under.

2.05 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 2. The Metraflex Company; _____: www.metraflex.com/#sle.
 - 3. Flexicraft; https://www.flexicraft.com/Metal_Expansion_Joints
 - 4. Substitutions: Division 01, Product Requirements.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 15/16 inch.
- D. Maximum Extension: 5/16 inch.
- E. Maximum Offset: 1/8 inch.
- F. Size: Use pipe sized units.
- G. Application: Steel piping over 2 inches.

2.06 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR

- A. Manufacturers:
 - 1. Flex-Hose Co. Inc; _____: www.flexhose.com/#sle.
 - 2. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company; Cablesphere: www.metraflex.com/#sle.
 - 4. Unisource Manufacturing, Inc; Series 301, Single Sphere Connectors: www.unisource-mfg.com/#sle.
 - 5. Flexicraft; https://www.flexicraft.com/Metal_Expansion_Joints
 - 6. Substitutions: Division 01, Product Requirements.
- B. Body Construction: Nylon-reinforced rubber tube.
- C. Cover and Tube Elastomer: EPDM and EPDM.
- D. End Connections: Carbon steel flanges.
- E. Maximum Elongation: 3/8 inch.
- F. Maximum Angular Movement: 15 degrees.

2.07 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

- A. Manufacturers:
 - 1. Flex-Weld, Inc; _____: www.kelcoind.com/#sle.
 - 2. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 3. Flexicraft; https://www.flexicraft.com/Metal_Expansion_Joints
 - 4. Substitutions: Division 01, Product Requirements.
- B. Construction: Bronze with anti-torque device, limit stops, internal guides.
- C. Pressure Rating: 125 psi and 400 degrees F.
- D. Maximum Compression: 1-3/4 inches.
- E. Maximum Extension: 1/4 inch.
- F. Application: Copper piping.

2.08 EXPANSION JOINTS - COMPENSATORS

- A. Manufacturers:
 - 1. Flex-Hose Co. Inc; _____: www.flexhose.com/#sle.
 - 2. Mercer Rubber Company; _____: www.mercer-rubber.com/#sle.
 - 3. The Metraflex Company; _____: www.metraflex.com/#sle.

4. Unisource Manufacturing, Inc; Series 416, Expansion Compensators: www.unisource-mfg.com/#sle.
 5. Substitutions: Division 01, Product Requirements.
- B. Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
- C. Maximum Working Pressure: 200 psi.
- D. Maximum Working Temperatures: 400 degrees F.
- E. Maximum Compression: 1/2 inch.
- F. Maximum Extension: 5/32 inch.
- G. End Connections: Female copper sweat.
- H. Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.09 EXPANSION JOINTS - HOSE AND BRAID

- A. Manufacturers:
1. Flex-Hose Co. Inc; V-Loop: www.flexhose.com/#sle.
 2. Flex-Weld, Inc; Keflex Ke-Loop: www.kelcoind.com/#sle.
 3. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
 4. Unisource Manufacturing, Inc; V-Loop: www.unisource-mfg.com/#sle.
 5. Substitutions: Division 01, Product Requirements.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
- D. Maximum Working Pressure: 150 psi at 800 degrees F.
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
1. Selected Product to Accommodate:
 - a. Compression and Expansion Axial Deflection: _____ inch.
 - b. Angular Rotation: 15 degrees.
 - c. Force developed by 1.5 times specified maximum allowable operating pressure.
 2. Provide necessary accessories including, but not limited to, swivel joints.

2.10 ACCESSORIES

- A. Pipe Alignment Guides:
1. Manufacturers:
 - a. Flex-Weld, Inc; _____: www.kelcoind.com/#sle.
 - b. Substitutions: Division 01, Product Requirements.
- B. Engineered Riser Anchor Clamps:
1. Manufacturers:
 - a. The Metraflex Company; Engineered Riser Anchor Clamp: www.metraflex.com/#sle.
 - b. Weicco; <https://www.weicco.com/>
 - c. Substitutions: Division 01, Product Requirements.
 2. Applications:
 - a. Provide one clamp to serve as a riser clip.
 - b. Provide one clamp above and one clamp below the slab to anchor pipe.
 3. Provide two piece, ductile iron in compliance with ASTM A536. Use with metal pipes with an outer diameter of 2.5 inches to 8 inches.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where shown on plans or required.

END OF SECTION 23 0516

**SECTION 23 0517
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section 23 0523 - General-Duty Valves for HVAC Piping.
- D. Section 23 0553 - Identification for HVAC Piping and Equipment: Piping identification.
- E. Section 23 0716 - HVAC Equipment Insulation.
- F. Section 23 0719 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
 - 2. American Polywater Corporation; PZVR Watertight Wall Sleeves for Pipes: www.polywater-haufftechnik.com/#sle.
 - 3. Calpico Inc : www.calpicoinc.com.
 - 4. Metraflex : www.metraflex.com.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Clearances:
 - 1. Provide allowance for insulated piping.
 - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
 - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.

2.02 PIPE-SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
 - 2. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
 - 3. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
- B. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening, 20 psi.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Underground, buried, and wet conditions.
 - c. Fire Resistant: 1 hour, UL (DIR) approved.
 - 5. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
 - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 - 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:
 - 1. Bearing Walls: Steel or cast iron pipe.
 - 2. Masonry Structures: Sheet metal, cast iron, or PVC.
- E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Structural Considerations:
 - 1. Do not penetrate building structural members unless indicated.

- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Underground Piping: Caulk pipe sleeve watertight with grout, silicone sealant or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 - 2. Aboveground Piping:
 - a. Pack solid using mineral fiber in compliance with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
- F. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Division 07 to prevent the spread of fire, smoke, and gases.
- G. Caulk exterior wall sleeves watertight with grout or silicone sealant
- H. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.
 - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 - 5. Tighten bolting for a water-tight seal.
 - 6. Install in accordance with manufacturer's recommendations.
- I. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 23 0517

**SECTION 23 0519
METERS AND GAUGES FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Positive displacement meters.
- B. Flow meters.
- C. Pressure gauges and pressure gauge taps.
- D. Thermometers and thermometer wells.
- E. Static pressure gauges.
- F. Filter gauges.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- C. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2025).
- D. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2025).
- E. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- F. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2024.
- G. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2024.
- H. AWWA C702 - Cold-Water Meters -- Compound Type; 2024.
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Operation and Maintenance Data: _____.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.

- B. Meter: Brass body turbine meter with magnetic drive register.
 - 1. Service: Cold water, 122 degrees F.
 - 2. Service: Hot water, 200 degrees F.
 - 3. Accuracy: 1-1/2 percent.
 - 4. Maximum Counter Reading: 10 million gallons.

2.02 LIQUID FLOW METERS

- A. Calibrated ASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.
- B. Annular element flow stations with meter set.
 - 1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - a. Pressure rating: 275 psi.
 - b. Maximum temperature: 400 degrees F.
 - c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.03 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi and KPa.

2.04 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

2.05 STEM TYPE THERMOMETERS

- A. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: 3/4" or 1/2 of pipe diameter inch brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.

2.06 DIAL THERMOMETERS

- A. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 - 1. Size: 5 inch diameter dial.

2. Lens: Clear glass.
3. Calibration: Degrees F.

2.07 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.08 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.
- B. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- C. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F.

2.09 STATIC PRESSURE GAUGES

- A. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets.
- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION 23 0519

**SECTION 23 0523
GENERAL-DUTY VALVES FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Flow limiting valves.
- F. Gate valves.
- G. Globe valves.
- H. Plug valves.
- I. Chainwheels.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 0553 - Identification for HVAC Piping and Equipment.
- C. Section 23 0716 - HVAC Equipment Insulation.
- D. Section 23 0719 - HVAC Piping Insulation.
- E. Section 23 2113 - Hydronic Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.
- J. WSP: Working steam pressure.

1.04 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- H. ASME B31.1 - Power Piping; 2024.

- I. ASME B31.9 - Building Services Piping; 2025.
- J. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- K. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- L. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- M. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service; 2021.
- N. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts; 2024, with Editorial Revision (2025).
- O. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- P. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- Q. ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars; 2022.
- R. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- S. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- T. AWWA C606 - Grooved and Shouldered Joints; 2022.
- U. MSS SP-45 - Drain and Bypass Connections; 2020.
- V. MSS SP-67 - Butterfly Valves; 2022.
- W. MSS SP-68 - High Pressure Butterfly Valves with Offset Design; 2021.
- X. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- Y. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- Z. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- AA. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- BB. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- CC. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- DD. MSS SP-108 - Resilient-Seated Cast Iron Eccentric Plug Valves; 2020.
- EE. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- FF. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Division 01, Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Throttling (Hydronic): Butterfly, Ball, Globe, and Angle.
 - 2. Isolation (Shutoff): Butterfly, Gate, Ball, and Plug.
 - 3. Swing Check (Pump Outlet):
 - a. Size 2 inch and Smaller: Bronze with bronze disc.
 - b. Size 2-1/2 inch and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
 - 4. Dead-End: Butterfly, single-flange (lug) type.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Chilled Water Valves:
 - 1. Size 2 inch and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Angle: Bronze disc, Class 125.
 - c. Ball: Full port, one piece, brass trim.
 - d. Swing Check: Bronze disc, Class.
 - e. Gate: NRS, Class 125.
 - f. Globe: Bronze disc, Class 125.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 inch to 4 inch: Threaded ends.
 - b. Ball: 2-1/2 NPS to 10 inch, Class 150.

- c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
 - d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
 - e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
 - f. Butterfly: High performance, single flange, Class 150.
 - g. Swing Check: Metal seats, Class 125.
 - h. Swing Check with Closure Control: 2-1/2 inch to 12 inch, lever and spring, Class 125.
 - i. Grooved-End Check: 3 inch to 12 inch, 300 CWP.
 - j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
 - k. Plate-Type Check: Single plate, metal seat, Class 125.
 - l. Globe: Class 125.
 - m. Lubricated Plug: Regular gland, threaded, Class 125.
 - n. Eccentric Plug: Resilient seating, 175 CWP.
- F. Heating Hot Water Valves:
- 1. Size 2 inch and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Angle: Bronze disc, Class 125.
 - c. Ball: Full port, one piece, brass trim.
 - d. Gate: NRS, Class 125.
 - e. Globe: Bronze disc, Class 125.
 - 2. Size 2-1/2 inch and Larger, Iron Valves:
 - a. 2-1/2 inch to 4 inch: Threaded ends.
 - b. Ball: 2-1/2 inch to 10 inch, Class 150.
 - c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
 - d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
 - e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
 - f. Butterfly: High performance, single flange, Class 150.
 - g. Swing Check: Metal seats, Class 125.
 - h. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
 - i. Grooved-End Swing Check: 3 inch to 12 inch, 300 CWP.
 - j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
 - k. Plate-Type Check: Single plate, metal seat, Class 125 .
 - l. Gate: NRS, Class 125.
 - m. Globe: 2-1/2 inch to 12 inch, Class 125.

2.02 GENERAL REQUIREMENTS

- A. Manufacturers:
- 1. Apollo
 - 2. Armstrong
 - 3. Bell and Gossett
 - 4. Jomar
 - 5. Legend
 - 6. Milwaukee
 - 7. Nibco
 - 8. Red-White
 - 9. Victaulic
 - 10. Watts
 - 11. Substitutions: See Section 016000-Product Requirements.

- B. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- C. Valve Sizes: Match upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 6 inch and smaller.
 - 4. Wrench: Plug valves with square heads.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- F. Memory Stops: Fully adjustable after insulation is installed.
- G. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.
- H. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Power Piping Valves: ASME B31.1.
 - 3. Building Services Piping Valves: ASME B31.9.
- I. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- J. Valve Bypass and Drain Connections: MSS SP-45.
- K. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

- A. CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded.
 - 4. Stem: Bronze.
 - 5. Disc: Bronze, PTFE, or TFE.
 - 6. Packing: Asbestos free.
 - 7. Handwheel: Bronze or aluminum.

2.04 BRONZE, GLOBE VALVES

- A. CWP Rating: Class 125: 200 psi:
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded or solder joint.
 - 4. Stem and Disc: Bronze or PTFE.
 - 5. Packing: Asbestos free.

6. Handwheel: Malleable iron.

2.05 BRONZE, GLOBE VALVES

- A. Ratings for Class 125 and Class 250:
 1. Class 125:
 - a. WOG Rating: 200 psi.
 - b. WSP Rating: 125 psi, saturated.
 2. Class 250: WOG Rating; 300 psi.
 3. Comply with MSS SP-80, Type 1.
 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 5. End Connections: Threaded or solder.
 6. Bonnet: NRS; Nonrising Stem.
 7. Nonrising Stem: Bronze.
 8. Disc: PTFE.
 9. Packing: Asbestos free.
 10. Handwheel Operator: Malleable Iron.

2.06 IRON, GLOBE VALVES

- A. CWP Ratings: Class 125: 200 psi and Class 250: 500 psi:
 1. Comply with MSS SP-85, Type I.
 2. Body: Gray iron; ASTM A126, with bolted bonnet.
 3. Ends: Flanged.
 4. Trim: Bronze.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Handwheel or chainwheel.

2.07 CARBON STEEL, GLOBE VALVES

- A. Class 150:
 1. Body: ASTM A216/A216M.
 2. WOG Rating: 150 psi.
 3. Bonnet: NRS; Nonrising Stem.
 4. End Connections: Flanged.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Malleable Iron handwheel.
 7. Pressure and Temperature Rating: ASME B16.34.
- B. Class 300:
 1. Body: ASTM A216/A216M.
 2. WOG Rating: 300 psi.
 3. Bonnet: NRS; Nonrising Stem.
 4. End Connections: Flanged.
 5. Packing and Gasket: Asbestos free.
 6. Operator: Malleable iron handwheel.
 7. Pressure and Temperature Rating: ASME B16.34.

2.08 STAINLESS STEEL, GLOBE VALVES

- A. Class 125:
 1. Body and Disc: ASTM A351/A351M-CF8M.
 2. WOG Rating: 200 psi.
 3. Bonnet: NRS; Nonrising Stem.
 4. End Connections: Threaded.
 5. Stem Packing: PTFE.
 6. Operator: Malleable Iron handwheel.
 7. Temperature Range: Minus 4 to 356 degrees F.
 8. Pressure and Temperature Rating: ASME B16.34.

- B. Class 150:
 - 1. Body and Disc: ASTM A351/A351M-CF8M.
 - 2. Bonnet: NRS; Nonrising Stem.
 - 3. WOG Rating: 150 psi.
 - 4. End Connections: Flanged.
 - 5. Trim: Stainless steel.
 - 6. Packing and Gasket: Asbestos free.
 - 7. Operator: Malleable Iron handwheel.
 - 8. Pressure and Temperature Rating: ASME B16.34.

2.09 BRASS, BALL VALVES

- A. One Piece, Full Port with Brass Trim and Push-to-fit or Threaded Connections:
 - 1. Comply with MSS SP-110.
 - 2. CWP Rating: 200 psi.
 - 3. Body: Forged brass.
 - 4. Ends: Threaded.
 - 5. Seats: PTFE or TFE.
 - 6. Stem: Brass.
 - 7. Ball: Chrome-plated brass.
- B. Two Piece, Full Port with Stainless Steel Trim and Female Thread, Male thread, or Solder Connections:
 - 1. Comply with MSS SP-110.
 - 2. SWP Rating: 150 psi.
 - 3. WOG Rating: 600 psi.
 - 4. Vacuum Rating: 28.9 in-Hg.
 - 5. Body: Forged brass.
 - 6. Seats: PTFE.
 - 7. Stem: Stainless Steel.
 - 8. Ball: Chrome-plated brass.
 - 9. Hose-End Applications: Provide 3/4-inch hose connection. Include cap, gasket, and chain or tether.
- C. Two Piece, Full Port with Pex Connections:
 - 1. CWP Rating: 400 psi.
 - 2. Body: Forged brass.
 - 3. Seats: PTFE.
 - 4. Ball: Chrome-plated brass.
 - 5. Blowout Proof Stem: Forged brass.
 - 6. Maximum Service Temperature: 250 degrees F.
- D. Two Piece, Full Port with Press Connection:
 - 1. WOG Rating: 250 psi.
 - 2. Body: Forged brass.
 - 3. Seats: EPDM.
 - 4. Ball: Chrome-plated brass.
 - 5. Blowout Proof Stem: Forged brass.
 - 6. Hose-End Applications: Provide 3/4-inch hose connection. Include cap, gasket, and chain or tether.
 - 7. Maximum Service Temperature: 250 degrees F.
- E. Three Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi.
 - 3. CWP Rating: 600 psi.
 - 4. Body: Forged brass.

5. Ends: Threaded.

2.10 BRONZE, BALL VALVES

- A. General:
 1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. One Piece, Reduced Port with Bronze Trim:
 1. Comply with MSS SP-110.
 2. CWP Rating: 400 psi.
 3. Ends: Threaded.
 4. Seats: PTFE.
 5. Stem: Bronze.
 6. Ball: Chrome plated brass.
- C. Two Piece, Full Port with Bronze or Brass Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. WOG Rating: 400 psi.
 4. Body: Forged bronze or dezincified-brass alloy.
 5. Seats: PTFE.
 6. Stem: Bronze or brass.
 7. Ball: Chrome plated brass.
- D. Three Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 600 psi.
 4. Seats: PTFE.
 5. Stem: Stainless steel.
 6. Ball: Stainless steel, vented.

2.11 STAINLESS STEEL, BALL VALVES

- A. One-Piece, Standard Port with Stainless-Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 1,000 psi.
 4. Seats: PTFE.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel.
- B. One Piece, Standard Port, Class 150, Flanged with Stainless Steel Trim:
 1. WSP Rating: 150 psi.
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
- C. Two Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 1,000 psi.
 4. Vacuum Rating: 14.2 psi.
 5. Body: Stainless steel.
 6. Seats: PFTE.
 7. Stem: Stainless steel, blowout proof.

8. Ball: Stainless steel, vented.
- D. Two Piece, Full Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
 1. WSP Rating: 150 psi.
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel, vented.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
- E. Three Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. WOG Rating: 1,000 psi.
 4. Seats: PFTE.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel, vented.
 7. Bolts: Stainless steel.
 8. Comply with ASME B16.34 for pressure-temperature range.

2.12 CARBON STEEL, BALL VALVES

- A. Class 150, Full Port, Stainless Steel Trim, Flanged:
 1. Comply with MSS SP-72.
 2. WOG Rating: 300 psi.
 3. WSP Rating: 150 psi.
 4. Body: Carbon steel, ASTM A216/A216M, Type WCB.
 5. Seats: PTFE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel, vented.
 8. Size: 1/2 to 12 inches.
- B. Class 150, Full Port, Stainless Steel Trim, Threaded with Lockable Handle:
 1. WOG Rating: 125 psi.
 2. WSP Rating: 150 psi.
 3. Vacuum Rating: 14.2 psi.
 4. Body: Carbon steel, ASTM A216/A216M.
 5. Seats: PTFE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.
 8. Size: 1/4 to 2 inches.
- C. One Piece, Standard Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
 1. WSP Rating: 150 psi, fire safe.
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel, vented.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
- D. Two Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi.
 3. CWP Rating: 2,000 psi.
 4. Seats: TFM.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel, vented.
 7. End Connections: Threaded or socket weld.

8. Operator: Lockable handle.
9. Pressure and Temperature Rating: ASME B16.34.
- E. Two Piece, Full Port, Fire Safe, Class 150, Flanged with Stainless Steel Trim:
 1. WSP Rating: 150 psi.
 2. Seats: TFM.
 3. Stem: Stainless steel, blowout proof.
 4. Ball: Stainless steel, vented.
 5. Operator: Lockable handle with actuator-mounting pad.
 6. Pressure and Temperature Rating: ASME B16.34.
- F. Three Piece, Full Port with Stainless Steel Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 250 psi.
 3. CWP Rating: 2,000 psi.
 4. Seats: TFM.
 5. Stem: Stainless steel, blowout proof.
 6. Ball: Stainless steel, vented.
 7. Bolts: Stainless steel.
 8. End Connections: Threaded or socket weld.
 9. Operator: Lockable handle.
 10. Pressure and Temperature Rating: ASME B16.34.

2.13 IRON, BALL VALVES

- A. Split Body, Full Port:
 1. Comply with MSS SP-72.
 2. CWP Rating: 200 psi.
 3. Body: ASTM A126, gray iron.
 4. Ends: Flanged.
 5. Seats: PTFE.
 6. Stem: Stainless steel.
 7. Ball: Stainless steel.

2.14 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Wafer and Lug Style:
 1. Comply with MSS SP-67, Type I.
 2. Lug Style, CWP Ratings:
 - a. Sizes 2 to 12 inch: 150 psi.
 - b. Sizes 14 to 24 inch: 250 psi.
 3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
 4. Stem: One or two-piece stainless steel.
 5. Seat: NBR.
 6. Disc: Aluminum-bronze.

2.15 IRON, GROOVED-END BUTTERFLY VALVES

- A. CWP Rating: 175 psi.
 1. Comply with MSS SP-67, Type I.
 2. Body: Coated ductile iron.
 3. Stem: Two-piece stainless steel.
 4. Disc: Coated ductile iron.
 5. Disc Seal: EPDM.

2.16 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug type; Bidirectional dead end service without downstream flange:
 1. Comply with MSS SP-68.
 2. Class 150: CWP Rating: 285 psi at 100 degrees F.

3. Class 300: CWP Rating: 720 psi at 100 degrees F.
4. Body: Provide carbon steel, cast iron, ductile Iron, or stainless steel.
5. Seat: Metal or reinforced PTFE.
6. Offset stem: Stainless steel.
7. Disc: Carbon steel.

2.17 BRASS, INLINE CHECK VALVES

- A. Class 150: CWP Rating: 200 psi .
- B. Maximum Service Temperature: 250 degrees F.
- C. Body: Forged brass.
- D. Disc: Forged brass.
- E. Seal: PTFE, bubble tight.
- F. End-Connections: Press.

2.18 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psi.
- B. Body: Forged brass.
- C. Disc: Forged brass.
- D. Hinge-Pin, Screw, and Cap: Forged brass.

2.19 BRONZE, LIFT CHECK VALVES

- A. Class 125:
 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 2. CWP Rating: 200 psi.
 3. Design: Vertical flow.
 4. Body: Bronze.
 5. Ends: Threaded.
 6. Disc (Type 1): Bronze.
 7. Disc (Type 2): NBR or PTFE.

2.20 BRONZE, SWING CHECK VALVES

- A. Class 125:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. WSP Rating: 200 psi.
 4. Body: Bronze, ASTM B62.
 5. End Connections: Threaded or soldered.
 6. Disc: Bronze.
- B. Class 150:
 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 2. Design: Y-pattern, horizontal or vertical flow.
 3. CWP Rating: 300 psi.
 4. Body: Bronze, ASTM B62.
 5. End Connections: Threaded or soldered.
 6. Disc: Bronze.

2.21 IRON, FLANGED END SWING CHECK VALVES

- A. Class 125:
 1. 150 psi with metal seats.
 2. 200 psi with metal seats and nonmetallic-to-metal seats.
- B. Class 250:

1. 300 psi with metal seats.
2. 500 psi with metal seats.

2.22 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125:
1. Comply with MSS SP-71, Type I.
 2. Body Design: Clear or full waterway.
 3. Body Material: ASTM A126, gray iron with bolted bonnet.
 4. Ends: Flanged.
 5. Trim: Bronze.
 6. Gasket: Asbestos free.
 7. Closer Control: Factory installed, exterior lever, and spring or weight.

2.23 CARBON STEEL, SWING CHECK VALVES

- A. Class 150:
1. Design: T-pattern, horizontal or vertical flow.
 2. Body and Disc: ASTM A216/A216M.
 3. CWP Rating: 150 psi.
 4. End Connections: Flanged.
 5. Pressure and Temperature Rating: ASME B16.34.
- B. Class 300:
1. Design: T-pattern, horizontal or vertical flow.
 2. Body and Disc: ASTM A216/A216M.
 3. CWP Rating: 300 psi.
 4. End Connections: Flanged.
 5. Pressure and Temperature Rating: ASME B16.34.

2.24 STAINLESS STEEL, SWING CHECK VALVES

- A. Class 150:
1. Body and Disc: ASTM A351/A351M-CF8M.
 2. Design: T-pattern, horizontal or vertical flow.
 3. CWP Rating: 150 psi.
 4. Connection Ends: Flanged.
 5. Pressure and Temperature Rating: ASME B16.34.
- B. Class 300:
1. Body and Disc: ASTM A351/A351M-CF8M.
 2. Design: T-pattern, horizontal or vertical flow.
 3. CWP Rating: 300 psi.
 4. Connection Ends: Flanged.
 5. Pressure and Temperature Rating: ASME B16.34.

2.25 IRON, GROOVED-END SWING CHECK VALVES

- A. Class 300:
1. CWP Rating: 300 psi.
 2. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
 3. Seal: EPDM or Nitrile.
 4. Disc: Ductile iron.
 5. Coating: Black, non-lead paint.

2.26 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Compact-Wafer:
1. Comply with MSS SP-125.
 2. Body Material: ASTM A126, gray iron.
 3. Metal Seat: Bronze.

4. Resilient Seat: EPDM or NBR.
- B. Class 125, Globe:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
 3. Body Material: ASTM A126, gray iron.
 4. Style: Spring loaded.
 5. Ends: Flanged.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- C. Class 150, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
 4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Metal Seat: Bronze.
 6. Resilient Seat: EPDM or NBR.
- D. Class 150, Globe:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
 4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Style: Spring loaded.
 6. Ends: Flanged.
 7. Metal Seat: Bronze.
 8. Resilient Seat: EPDM or NBR.
- E. Class 250, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 400 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 300 psi.
 4. Body Material: ASTM A126, gray iron.
 5. Style: Spring loaded.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- F. Class 250, Globe:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 400 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 300 psi.
 4. Body Material: ASTM A126, gray iron.
 5. Style: Spring loaded.
 6. Ends: Flanged.
 7. Metal Seat: Bronze.
- G. Class 300, Compact-Wafer:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 500 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 400 psi.
 4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 5. Style: Spring loaded.
 6. Resilient Seat: EPDM or NBR.
- H. Class 300, Globe:
 1. Comply with MSS SP-125.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 500 psi.

3. Sizes 14 to 24 inch: CWP Rating; 400 psi.
4. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
5. Style: Spring loaded.
6. Ends: Flanged.
7. Metal Seat: Bronze.
8. Resilient Seat: EPDM or NBR.

2.27 IRON, PLATE-TYPE CHECK VALVES

- A. Class 125 Single-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
 4. Body Design: Wafer, spring-loaded plate.
 5. Body Material: ASTM A126, gray iron.
 6. Resilient Seat: EPDM or NBR.
- B. Class 125 Dual-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
 4. Body Design: Wafer, spring-loaded plates.
 5. Body Material: ASTM A126, gray iron.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- C. Class 150 Dual-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 250 psi.
 4. Body Design: Wafer, spring-loaded plates.
 5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- D. Class 250 Dual-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 400 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 300 psi.
 4. Body Design: Wafer, spring-loaded plates.
 5. Body Material: ASTM A126, gray iron.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- E. Class 300 Dual-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 500 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 400 psi.
 4. Body Design: Wafer, spring-loaded plates.
 5. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
 6. Metal Seat: Bronze.
 7. Resilient Seat: EPDM or NBR.
- F. Class 250 Wafer, Single-Plate:
 1. Comply with API STD 594.
 2. Sizes 2-1/2 to 12 inch: CWP Rating; 400 psi.
 3. Sizes 14 to 24 inch: CWP Rating; 300 psi.
 4. Body Design: Wafer, spring-loaded plate.

5. Body Material: ASTM A126, gray iron.
6. Resilient Seat: EPDM or NBR.

2.28 BRONZE, GATE VALVES

- A. Rising Stem or OS&Y:
 1. Pressure-Temperature Range: MSS SP-80, Type I.
 2. Class 125:
 - a. WSP Rating: 125 psi, saturated.
 - b. CWP Rating: 200 psi.
 3. Class 150: CWP Rating; 300 psi.
 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 5. End Connections: Threaded or solder.
 6. Stem: Bronze.
 7. Disc: Solid wedge; bronze.
 8. Packing: Asbestos free.
 9. Handwheel Operator: Malleable iron, bronze, or aluminum.
- B. Nonrising Stem or NRS:
 1. Pressure-Temperature Range: MSS SP-80, Type I.
 2. Class 125:
 - a. WSP Rating: 125 psi, saturated.
 - b. CWP Rating: 200 psi.
 3. Class 150: CWP Rating; 300 psi.
 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 5. Ends Connections: Threaded or solder.
 6. Stem: Bronze.
 7. Disc: Solid wedge; bronze.
 8. Packing: Asbestos free.
 9. Handwheel Operator: Malleable iron, bronze, or aluminum.
- C. Nonrising Stem (NRS) or Rising Stem (RS):
 1. Comply with MSS SP-80, Type I.
 2. Class 125: CWP Rating; 200 psi.
 3. Class 150: CWP Rating; 300 psi.
 4. Body Material: Bronze with integral seat and union-ring bonnet.
 5. Ends: Threaded.
 6. Stem: Bronze.
 7. Disc: Solid wedge; bronze.
 8. Packing: Asbestos free.
 9. Handwheel: Malleable iron, bronze, or aluminum.

2.29 IRON, GATE VALVES

- A. NRS or OS&Y:
 1. Comply with MSS SP-70, Type I.
 2. Class 125:
 - a. Sizes 2-1/2 to 12 inch, CWP Rating; 200 psi.
 - b. Sizes 14 to 24 inch, CWP Rating; 500 psi.
 3. Class 250:
 - a. Sizes 2-1/2 to 12 inch, CWP Rating; 500 psi.
 - b. Sizes 14 to 24 inch, CWP Rating; 300 psi.
 4. Body Material: Gray iron with bolted bonnet.
 5. Ends: Flanged.
 6. Trim: Bronze.
 7. Disc: Solid wedge.
 8. Packing and Gasket: Asbestos free.

2.30 CARBON STEEL, GATE VALVES

- A. Class 150:
 - 1. Body and Disc: ASTM A216/A216M.
 - 2. CWP Rating: 150 psi.
 - 3. Bolted Bonnet: OS&Y; Rising Stem.
 - 4. End Connections: Flanged.
 - 5. Packing and Gasket: Asbestos free.
 - 6. Pressure and Temperature Rating: ASME B16.34.
- B. Class 300:
 - 1. Body and Disc: ASTM A216/A216M.
 - 2. CWP Rating: 300 psi.
 - 3. Bolted Bonnet: OS&Y; Rising Stem.
 - 4. End Connections: Flanged.
 - 5. Packing and Gasket: Asbestos free.
 - 6. Pressure and Temperature Rating: ASME B16.34.

2.31 STAINLESS STEEL, GATE VALVES

- A. Class 125:
 - 1. Body and Disc: ASTM A351/A351M-CF8M.
 - 2. WOG Rating: 125 psi.
 - 3. Bonnet: NRS; Nonrising Stem.
 - 4. End Connections: Threaded.
 - 5. Adjustable Stem Packing: PTFE.
 - 6. Operator: Handwheel.
 - 7. Working Service Temperature: Minus 4 to 356 degrees F.
 - 8. Pressure and Temperature Rating: ASME B16.34.
- B. Class 150:
 - 1. Body and Disc: ASTM A351/A351M-CF8M.
 - 2. WOG Rating: 150 psi.
 - 3. Bolted Bonnet: OS&Y; Rising Stem.
 - 4. End Connections: Flanged.
 - 5. Packing and Gasket: Asbestos free.
 - 6. Operator: Handwheel.
 - 7. Pressure and Temperature Rating: ASME B16.34.
- C. Class 300:
 - 1. Body and Disc: ASTM A351/A351M-CF8M.
 - 2. WOG Rating: 300 psi.
 - 3. Bolted Bonnet: OS&Y; Rising Stem.
 - 4. End Connections: Flanged.
 - 5. Packing and Gasket: Asbestos free.
 - 6. Operator: Handwheel.
 - 7. Pressure and Temperature Rating: ASME B16.34.

2.32 LUBRICATED PLUG VALVES

- A. Regular Gland and Cylindrical with Threaded Ends:
 - 1. Comply with MSS SP-78, Type II.
 - 2. Class 150:
 - a. Sizes 2-1/2 to 12 inch , CWP Rating; 200 psi.
 - b. Sizes 14 to 24 inch, CWP Rating; 150 psi.
 - 3. Class 250:
 - a. Sizes 2-1/2 to 12 inch, CWP Rating; 400 psi.
 - b. Sizes 14 to 24 inch, CWP Rating; 300 psi.

4. Body Material: Cast iron with lubrication sealing system.
5. Pattern: Regular or short.
6. Plug: Cast iron or bronze with sealant groove.

2.33 ECCENTRIC PLUG VALVES

- A. Resilient Seating with Flanged Ends.
 1. Comply with MSS SP-108.
 2. CWP Rating: 175 psi minimum.
 3. Body and Plug: Gray or ductile iron.
 4. Bearings: Oil-impregnated bronze or Stainless Steel.
 5. Stem-Seal Packing: Asbestos free.
 6. Plug, Resilient-Seating Material: Approved for potable water service.

2.34 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball, butterfly, and plug valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
 1. Lift Check: Install with stem plumb and vertical.
 2. Swing Check: Install horizontal maintaining hinge pin level.
 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.
- E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 inches or more above finished floor, terminating 60 inches above finished floor.

END OF SECTION 23 0523

**SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- I. FM (AG) - FM Approval Guide; Current Edition.
- J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- K. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Division 03.

1.04 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of mechanical work.
 - 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. Strut Channel or Bracket Material:
 - 2. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
- D. Pipe Supports:
 - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 2. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 - 3. Operating Temperatures from 122 to 446 degrees F:
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
- E. Pipe Stanchions:
 - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 - 3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- F. Beam Clamps:
 - 1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 - 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 - 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 - 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 - 5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
 - 6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 - 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 - 8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- G. Insulation Clamps:
 - 1. Two bolt-type clamps designed for installation under insulation.
 - 2. Material: Carbon steel with epoxy copper or zinc finish.

H. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Engineer/Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Engineer/Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- G. Secure fasteners according to manufacturer's recommended torque settings.
- H. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 23 0529

**SECTION 23 0533
HEAT TRACING FOR HVAC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Self-regulating parallel resistance electric heating cable.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 23 0553 - Identification for HVAC Piping and Equipment.
- B. Section 23 0719 - HVAC Piping Insulation.
- C. Section 23 2113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

- A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2022.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data for electric heat tracing and controls.
- C. Shop Drawings: Indicate electric heat tracing and _____ layout, electrical terminations, thermostats, controls, branch circuit connections, and _____.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. BriskHeat Corporation: www.briskheat.com/#sle.
- B. Chromalox, Inc: www.chromalox.com/#sle.
- C. DwyerOmega Engineering Inc: www.dwyeromega.com/#sle.
- D. Emerson Electric Co: www.emerson.com/#sle.
- E. nVent RAYCHEM: www.raychem.com/#sle.
- F. Thermon Manufacturing Company: www.thermon.com/#sle.
- G. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

- A. Provide products listed, classified, and labeled by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction (AHJ).
- B. Factory Rating and Testing: Comply with IEEE 515.1.

- C. Heating Element:
 - 1. Provide pair of parallel No. 16 nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
 - 3. Capable of crossing over itself without overheating.
- D. Insulated Jacket: Flame retardant polyolefin.
- E. Cable Cover: Provide tinned copper and polyolefin or fluoropolymer outer jacket with UV inhibitor.
- F. Maximum Power-On Operating Temperature: 150 degrees F.
- G. Maximum Power-Off Exposure Temperature: 185 degrees F.
- H. Electrical Characteristics: (verify with Electrical Contractor prior to purchase)

2.03 OUTER JACKET MARKINGS

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Catalog number, reference number, or model.
- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.

2.04 CONNECTION KITS

- A. Provide power connection, splice/tee, end seal, and thermostat kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.

2.05 CONTROLS

- A. Manufacturers:
 - 1. Source Limitations: Furnish heat trace controls produced by same manufacturer as heat trace.
- B. System Controller:
 - 1. NEMA EN 10250 Type 4X enclosure.
 - 2. Microprocessor based.
 - 3. User interface with status indicator lights.
 - 4. BACnet connectivity via gateway.
 - 5. Diagnostic self-testing with field-adjustable testing interval.
 - 6. Ground fault equipment protection (GFEP) complying with UL 1053.
 - 7. Manual ON/OFF override control.
 - 8. Dry contact for alarm reporting.
 - 9. Alarms:
 - a. Ground fault.
 - b. Sensor failure.
 - c. Low temperature.
 - d. High temperature.
 - e. Low current.
 - f. High current.
 - g. Communications loss.
 - h. Power loss.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping and equipment are ready to receive work.

- B. Verify field measurements are as indicated on shop drawings.
- C. Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

- A. Clean all surfaces prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
- C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.
- D. Comply with all national and local code requirements.
- E. Identification:
 - 1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

END OF SECTION 23 0533

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 09, Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Project Record Documents: Record actual locations of tagged valves. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Nameplates
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Ductwork: Stencilled painting.
- G. Heat Transfer Equipment: Nameplates.
- H. Instrumentation: Tags.
- I. Major Control Components: Nameplates.
- J. Piping: Pipe markers.
- K. Pumps: Nameplates.
- L. Relays: Tags.
- M. Small-sized Equipment: Tags.
- N. Tanks: Nameplates.

- O. Thermostats: Nameplates.
- P. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- Q. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

- A. Letter Color: White.
- B. Letter Height: 1/4 inch.
- C. Background Color: Black.
- D. Plastic: Comply with ASTM D709.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Installed in mechanical room.

2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.
- B. Style: Individual Label.
- C. Color: Yellow/Black.
- D. Letter Height: 1 inch..

2.05 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. Over 2" Outside Diameter of Insulation or Pipe: 12 inch long color field, 1 inch high letters.
 - 4. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors complying with ASME A13.1.

2.06 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.
- E. Ammonia Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- F. Color code as follows:
 - 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
 - 2. Toxic and Corrosive Fluids: Orange with black letters.
 - 3. Compressed Air: Blue with white letters.

2.07 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Division 09.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Use tags on piping 3/4 inch diameter and smaller.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 23 0553

**SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2024, with Errata (2025).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2023.

1.03 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer/Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).

- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer/Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.

- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Effect system balance with automatic control valves fully open to heat transfer elements.
- D. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- E. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. HVAC Pumps.
 - 2. Water Tube Boilers.
 - 3. Air Cooled Water Chillers.
 - 4. Packaged Roof Top Heating/Cooling Units.
 - 5. Packaged Terminal Air Conditioning Units.
 - 6. Air Coils.
 - 7. Terminal Heat Transfer Units.
 - 8. Air Handling Units.
 - 9. Fans.
 - 10. Air Filters.
 - 11. Air Terminal Units.
 - 12. Air Inlets and Outlets.

3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 - 1. Manufacturer.
 - 2. Model/Frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Service factor.
 - 7. Starter size, rating, heater elements.
 - 8. Sheave Make/Size/Bore.
- B. V-Belt Drives:
 - 1. Identification/location.
 - 2. Required driven RPM.
 - 3. Driven sheave, diameter and RPM.
 - 4. Belt, size and quantity.
 - 5. Motor sheave diameter and RPM.
 - 6. Center to center distance, maximum, minimum, and actual.
- C. Pumps:
 - 1. Identification/number.
 - 2. Manufacturer.
 - 3. Size/model.
 - 4. Impeller.
 - 5. Service.
 - 6. Design flow rate, pressure drop, BHP.
 - 7. Actual flow rate, pressure drop, BHP.
 - 8. Discharge pressure.
 - 9. Suction pressure.
 - 10. Total operating head pressure.

11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.
- D. Combustion Equipment:
 1. Boiler manufacturer.
 2. Model number.
 3. Serial number.
 4. Firing rate.
 5. Overfire draft.
 6. Gas meter timing dial size.
 7. Gas meter time per revolution.
 8. Gas pressure at meter outlet.
 9. Gas flow rate.
 10. Heat input.
 11. Burner manifold gas pressure.
 12. Percent carbon monoxide (CO).
 13. Percent carbon dioxide (CO₂).
 14. Percent oxygen (O₂).
 15. Percent excess air.
 16. Flue gas temperature at outlet.
 17. Ambient temperature.
 18. Net stack temperature.
 19. Percent stack loss.
 20. Percent combustion efficiency.
 21. Heat output.
- E. Chillers:
 1. Identification/number.
 2. Manufacturer.
 3. Capacity.
 4. Model number.
 5. Serial number.
 6. Evaporator entering water temperature, design and actual.
 7. Evaporator leaving water temperature, design and actual.
 8. Evaporator pressure drop, design and actual.
 9. Evaporator water flow rate, design and actual.
- F. Cooling Coils:
 1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Entering air DB temperature, design and actual.
 7. Entering air WB temperature, design and actual.
 8. Leaving air DB temperature, design and actual.
 9. Leaving air WB temperature, design and actual.
 10. Water flow, design and actual.
 11. Water pressure drop, design and actual.
 12. Entering water temperature, design and actual.
 13. Leaving water temperature, design and actual.
 14. Saturated suction temperature, design and actual.
 15. Air pressure drop, design and actual.
- G. Heating Coils:

1. Identification/number.
 2. Location.
 3. Service.
 4. Manufacturer.
 5. Air flow, design and actual.
 6. Water flow, design and actual.
 7. Water pressure drop, design and actual.
 8. Entering water temperature, design and actual.
 9. Leaving water temperature, design and actual.
 10. Entering air temperature, design and actual.
 11. Leaving air temperature, design and actual.
 12. Air pressure drop, design and actual.
- H. Air Moving Equipment:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Arrangement/Class/Discharge.
 6. Air flow, specified and actual.
 7. Return air flow, specified and actual.
 8. Outside air flow, specified and actual.
 9. Total static pressure (total external), specified and actual.
 10. Inlet pressure.
 11. Discharge pressure.
 12. Sheave Make/Size/Bore.
 13. Number of Belts/Make/Size.
 14. Fan RPM.
- I. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design return air flow.
 5. Actual return air flow.
 6. Design outside air flow.
 7. Actual outside air flow.
 8. Return air temperature.
 9. Outside air temperature.
 10. Required mixed air temperature.
 11. Actual mixed air temperature.
 12. Design outside/return air ratio.
 13. Actual outside/return air ratio.
- J. Exhaust Fans:
1. Location.
 2. Manufacturer.
 3. Model number.
 4. Serial number.
 5. Air flow, specified and actual.
 6. Total static pressure (total external), specified and actual.
 7. Inlet pressure.
 8. Discharge pressure.
 9. Sheave Make/Size/Bore.
 10. Number of Belts/Make/Size.

11. Fan RPM.
- K. Duct Traverses:
 1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test air flow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- L. Terminal Unit Data:
 1. Manufacturer.
 2. Type, constant, variable, single, dual duct.
 3. Identification/number.
 4. Location.
 5. Model number.
 6. Size.
 7. Minimum static pressure.
 8. Minimum design air flow.
 9. Maximum design air flow.
 10. Maximum actual air flow.
 11. Inlet static pressure.
- M. Sound Level Reports:
 1. Location.
 2. Octave bands - equipment off.
 3. Octave bands - equipment on.
- N. Vibration Tests:
 1. Location of points:
 - a. Fan bearing, drive end.
 - b. Fan bearing, opposite end.
 - c. Motor bearing, center (if applicable).
 - d. Motor bearing, drive end.
 - e. Motor bearing, opposite end.
 - f. Casing (bottom or top).
 - g. Casing (side).
 - h. Duct after flexible connection (discharge).
 - i. Duct after flexible connection (suction).
 2. Test readings:
 - a. Horizontal, velocity and displacement.
 - b. Vertical, velocity and displacement.
 - c. Axial, velocity and displacement.
 3. Normally acceptable readings, velocity and acceleration.
 4. Unusual conditions at time of test.
 5. Vibration source (if non-complying).

END OF SECTION 23 0593

**SECTION 23 0713
DUCT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Weather barrier coatings.
- C. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A.

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2019 (Reapproved 2022).
- F. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers; 2015 (Reapproved 2022).
- G. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- H. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- I. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- L. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - 2. Johns Manville; _____: www.jm.com/#sle.
 - 3. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com/#sle.
 - 4. Knauf Insulation; Performance+ Duct Wrap: www.knaufinsulation.com/#sle.
 - 5. Manson Insulation, a company of Knauf Insulation; Alley Wrap B: www.imanson.com/#sle.
 - 6. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.
 - 7. Substitutions: Division 01, Product Requirements.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure-sensitive tape.
- C. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- D. Indoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- E. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - 2. Johns Manville; _____: www.jm.com/#sle.
 - 3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
 - 4. Manson Insulation, a company of Knauf Insulation; AK Board: www.imanson.com/#sle.
 - 5. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 - 6. Substitutions: Division 01, Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. Maximum Density: 8.0 pcf.
- C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
1. Aeroflex USA; AEROFLEX Breathe-EZ: www.aeroflexusa.com/#sle.
 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
 4. Substitutions: Division 01, Product Requirements
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.
1. Manufacturers:
 - a. Design Polymeric; DP 5050 Water Based, High Strength, Weather Barrier Coating: www.designpoly.com/#sle.

2.05 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 4. Color: As selected by Architect.

2.06 JACKETING AND ACCESSORIES

- A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
- B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.
- C. Aluminum Jacket:
1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- D. Aluminum-Foil Laminate Jacket:

1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
2. Comply with ASTM C1775.
- E. Aluminum-Foil Laminate Jacket:
 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- F. Flexible Weather-Proofing Outdoor Jacket: Self-healing, field-applied outdoor cladding.
 1. Material: Aluminum foil/polymer laminate with rubberized asphalt layer and acrylic adhesive.
 2. Thickness: 34 mil, 0.034 inch.
 3. Water Vapor Transmission: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 4. Mold Resistance: Pass when tested in accordance with ASTM C1338.
 5. Emissivity: 0.30 when tested in accordance with ASTM C1371.
- G. Reinforced Tape:
 1. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723 or ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Ducts Conveying Air Below Ambient Temperature:
 1. Provide insulation with vapor barrier jackets.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Ducts Conveying Air Above Ambient Temperature:
 1. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. Slope exterior ductwork to shed water.
- G. External Duct Insulation Application:
 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 2. Secure insulation without vapor barrier with staples, tape, or wires.
 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
 1. Adhere insulation with adhesive for 90 percent coverage.

2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

- A. Exhaust Ducts Within 10 ft of Exterior Openings:
- B. Outside Air Intake Ducts:
- C. Plenums:
- D. Supply Ducts:
- E. Return and Relief Ducts:
- F. Ducts Exposed to Outdoors and in attics:

END OF SECTION 23 0713

**SECTION 23 0716
HVAC EQUIPMENT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Equipment insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2024.
- K. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- L. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- M. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.
- N. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- O. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- P. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.

- R. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- S. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. CertainTeed Corporation; _____: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation; _____: www.jm.com/#sle.
 - 3. Knauf Insulation; Performance+ Duct Wrap: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation; [____]: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: Division 01, Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1,000 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

2.03 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Insulation: ASTM C553 Type V; flexible, noncombustible.
 - 1. Comply with ASTM C1695.
 - 2. K Value: 0.37 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Maximum Service Temperature: 500 degrees F.

2.04 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation; _____: www.certainteed.com/#sle.

2. Johns Manville Corporation; _____: www.jm.com/#sle.
 3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
 4. Manson Insulation, a company of Knauf Insulation; AK Board: www.imanson.com/#sle.
 5. Owens Corning Corporation; _____: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 1,200 degrees F.
 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 pcf.
- C. Aluminum-Foil Laminate Jacket:
1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- D. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.05 CELLULAR GLASS

- A. Manufacturer:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
- B. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
 2. Service Temperature Range: From 250 degrees F to 800 degrees F.
 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 4. Water Absorption: 0.5 percent by volume, maximum.
 5. Density: At least 6.12 pcf, minimum.
- C. Block Insulation: ASTM C552, Type I, Grade 6.
1. K Value: 0.35 at 100 degrees F.
 2. Service Temperature: 800 degrees F, maximum.
 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 4. Water Absorption: 0.5 percent by volume, maximum.
 5. Density: 6.12 pcf, minimum.

2.06 HYDROUS CALCIUM SILICATE

- A. Manufacturer:
1. Johns Manville Corporation; _____: www.jm.com/#sle.
- B. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 1,200 degrees F.
 3. Density: 15 pcf.
- C. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.
- D. Insulating Cement: ASTM C449.
- E. High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.

2.07 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
1. Aeroflex USA; AEROFLEX EPDM Sheet/Roll: www.aeroflexusa.com/#sle.

2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.08 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 2. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 4. Color: As selected by Architect.

2.09 JACKETING AND ACCESSORIES

- A. PVC Plastic:
 1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
 1. Lagging Adhesive: Compatible with insulation.
- C. Aluminum Jacket:
 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 2. Thickness: 0.016 inch sheet.
 3. Finish: Smooth.
 4. Joining: Longitudinal slip joints and 2 inch laps.
 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
- D. Aluminum-Foil Laminate Jacket:
 1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
- E. Reinforced Tape:
 1. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723 or ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- C. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- E. Insulated equipment containing fluids below ambient temperature; insulate entire system.
- F. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- G. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- H. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- I. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert Location: Between support shield and equipment and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- J. Finish insulation at supports, protrusions, and interruptions.
- K. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- L. Exterior Applications:
 - 1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
 - 2. Cover with aluminum or stainless steel.
- M. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- N. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- O. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Pump Bodies:
 - 2. Air Separators:
 - 3. Expansion Tanks:
- B. Cooling Systems:
 - 1. Pump Bodies:
 - 2. Air Separators:
 - 3. Expansion Tanks:
 - 4. Chiller Cold Surfaces (Not Factory Insulated):
 - 5. Equipment Exposed to Freezing with Heat Tracing:

END OF SECTION 23 0716

**SECTION 23 0719
HVAC PIPING INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

- A. Division 07, Firestopping.
- B. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).
- I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.
- J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- L. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.
- O. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- P. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- Q. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- R. ASTM C1695 - Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service; 2022.

- S. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- T. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- U. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
- V. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2025.
- W. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- X. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- Y. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- Z. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- AA. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. JP Lamborn Co; Thermal Sleeve MT: www.jpflex.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com
 - 3. Knauf Insulation: www.knaufinsulation.com
 - 4. Owens Corning Corporation: www.ocbuildingspec.com.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 1,200 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Aluminum-Foil Laminate Jacket:
 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- D. Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure-sensitive tape.
- E. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with pressure-sensitive rubber-based adhesive.
- F. Outdoor Vapor Barrier Mastic:
 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

- A. Manufacturers:
 1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville Corporation: www.jm.com/#sle.
 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 4. Manson Insulation, a company of Knauf Insulation: www.imanson.com/#sle.
 5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 1. K Value: ASTM C177, 0.23 at 75 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 1. K Value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum Service Temperature: 650 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- E. Aluminum-Foil Laminate Jacket:
 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- F. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- G. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- H. Vapor Barrier Lap Adhesive: Compatible with insulation.
- I. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- J. Fibrous Glass Fabric:
 1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Blanket: 1.0 pcf density.
- K. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd weight.

- 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- L. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- M. Insulating Cement: ASTM C449.

2.04 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Manufacturers:
 - 1. Auburn Manufacturing Inc; Ever Green Cut 'n Wrap: www.auburnmfg.com/#sle.
 - 2. Substitutions: Division 01, Product Requirements.
- B. Insulation: ASTM C553 Type V; flexible, noncombustible.
 - 1. Comply with ASTM C1695.
 - 2. K Value: 0.37 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 3. Minimum Service Temperature: 32 degrees F.
 - 4. Maximum Service Temperature: 500 degrees F.
 - 5. Maximum Water Vapor Absorption: 5.0 percent by weight.

2.05 CELLULAR GLASS

- A. Manufacturers:
 - 1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
 - 2. Substitutions: Division 01, Product Requirements.
- B. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
 - 1. K Value: 0.35 at 100 degrees F.
 - 2. Service Temperature Range: From 250 degrees F to 800 degrees F.
 - 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.
 - 5. Density: A minimum of 6.12 pcf.
- C. Block Insulation: ASTM C552, Type I, Grade 6.
 - 1. K Value: 0.35 at 100 degrees F.
 - 2. Service Temperature: 800 degrees F, maximum.
 - 3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

2.06 HYDROUS CALCIUM SILICATE

- A. Manufacturers:
 - 1. Johns Manville Corporation; _____: www.jm.com/#sle.
 - 2. Substitutions: Division 01, Product Requirements.
- B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
 - 1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 1200 degrees F.
 - 3. Density: 15 pcf.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Insulating Cement: ASTM C449.
- E. High Temperature Adhesive: Fire-retardant, sodium silicate based adhesive with fibers treated in compliance with ASTM D93.

2.07 POLYISOCYANURATE CELLULAR PLASTIC

- A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
 - 1. Dimension: Comply with requirements of ASTM C585.
 - 2. K Value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
 - 3. Minimum Service Temperature: Minus 70 degrees F.

4. Maximum Service Temperature: 300 degrees F.
5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
6. Moisture Vapor Transmission: 4.0 perm inch.
7. Connection: Waterproof vapor barrier adhesive.

2.08 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 1. Aeroflex USA; AEROFLEX Self-Seal: www.aeroflexusa.com/#sle.
 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
 3. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 180 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.09 WEATHER BARRIER COATINGS

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
 1. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating: www.fosterproducts.com/#sle.
 - b. Substitutions: Division 01, Product Requirements.
 2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 3. Water Vapor Permeance: Greater than 1.0 perm in accordance with ASTM E96/E96M.
 4. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 5. Color: As selected by Architect.

2.10 JACKETING AND ACCESSORIES

- A. PVC Plastic.
 1. Manufacturers:
 - a. Johns Manville Corporation; _____: www.jm.com/#sle.
 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch.
 - e. Connections: Brush on welding adhesive.
 3. Covering Adhesive Mastic: Compatible with insulation.
- B. ABS Plastic:
 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F.
 - b. Maximum Service Temperature: 180 degrees F.
 - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil, 0.030 inch.

- e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire-retardant lagging adhesive.
- D. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.
 - 3. Type: Factory-applied, self-adhesive jacketing.
 - 4. Finish: Smooth.
 - 5. Joining: Longitudinal slip joints and 2 inch laps.
 - 6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
- E. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing on paper release liner.
 - 2. Finish: Aluminum smooth.
 - 3. Comply with ASTM C1775.
- F. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- G. Stainless Steel Jacket: ASTM A666/A666M, Type 304 stainless steel.
 - 1. Thickness: 0.010 inch.
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- H. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723, ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
- I. Plain Foil Tape:
 - 1. Aluminum foil with pressure-sensitive adhesive on paper release liner.
 - 2. Finish: Plain foil.
- J. Vapor Barrier Membranes: ASTM C1136, Type IX.
 - 1. Multilayer Laminate Vapor Barrier:
 - a. Provide multilayer laminate with 1.0 mil, 0.001 inch foil, reversible.
 - b. Thickness: 2.4 mil, 0.002 inch.
 - c. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Manufacturers:
 - 1) Polyguard Products; ZERO-PERM: www.polyguardproducts.com/#sle.
 - 2. Rubberized Asphalt Vapor Barrier:
 - a. Thickness: 30 mil, 0.030 inch.
 - b. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - c. Manufacturers:
 - 1) Polyguard Products; Insulrap 30 NG: www.polyguardproducts.com/#sle.

2.11 ACCESSORIES

- A. General Requirements:
 - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
 - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.

3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
1. Corrosion Control Gel:
 - a. Manufacturers:
 - 1) Polyguard Products; RG2400LT: www.polyguardproducts.com/#sle.
 - b. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- G. Inserts and Shields:
 1. Application: Piping 1-1/2 inches diameter or larger.
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under the finish jacket.
 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Division 07.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with color coded PVC jacket and fitting covers.
- J. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

- K. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- L. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

- A. Heating Systems:
 - 1. Heating Water Supply and Return:
- B. Cooling Systems:
 - 1. Chilled Water:
 - 2. Cold Condensate Drains:
- C. Other Systems:
 - 1. Piping Exposed to Freezing with Heat Tracing:

END OF SECTION 23 0719

**SECTION 23 0923
DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. System description.
- B. Controllers.
- C. Power supplies and line filtering.
- D. System software.
- E. Controller software.
- F. HVAC control programs.
- G. Chiller control programs.

1.02 RELATED REQUIREMENTS

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- B. Section 23 0993 - Sequence of Operations for HVAC Controls.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h, with Editorial Revision (2022).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The building controls shall be a fully open protocol BACNET extension of York County's existing BAS webserver building management system with ASI controls . The webserver is located at the York County Government Center..

2.02 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.03 CONTROLLERS

- A. Building Controllers:
 - 1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.

- b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
- 2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 10 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- B. Application Specific Controllers:
 - 1. Manufacturers:
 - a. ASI Controls: www.asicontrols.com.
 - 2. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
 - 3. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 4. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 10 to 150 degrees F..

- b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 5. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 6. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 7. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- C. Input/Output Interface:
 - 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 - 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 - 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 - 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 - 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
 - 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
 - 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
 - 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:

- c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- 9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.04 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies:
 - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F.
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
 - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.05 SYSTEM SOFTWARE

- A. Operating System:
 - 1. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - (a) Analog and binary values.
 - (b) Dynamic text.
 - (c) Static text.
 - (d) Animation files.
 - 2. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics.
 - b. HTML graphics to support web browser compatible formats.
 - c. Capture or convert graphics from AutoCAD, Designer, and REVIT.
 - 3. Standard HVAC Graphics Library:
 - a. HVAC Equipment:
 - 1) Chillers.

- 2) Boilers.
 - 3) Air Handlers.
 - 4) Terminal HVAC Units.
 - 5) Fan Coil Units.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Pumps.
 - 3) Valves.
 - 4) Dampers.
- B. Workstation System Applications:
 - 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.
 - 3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
 - 4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
 - 5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
 - 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Modems.
 - 4) Network connections.
 - 5) Building management panels.
 - 6) Controllers.
 - b. Device failure is annunciated to the operator.
 - 7. Alarm Processing:
 - a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.

- 4) Reactions for each object.
8. Alarm Messages:
 - a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:
 - a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
10. Custom Trend Logs:
 - a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
 - a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
 - a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
13. Reports and Logs:
 - a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - d. Set to be printed on operator command or specific time(s).
14. Reports:
 - a. Standard:
 - 1) Objects with current values.
 - 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.

- 4) Objects in manual or automatic alarm lockout.
- 5) Objects in alarm lockout currently in alarm.
- 6) Logs:
 - (a) Alarm History.
 - (b) System messages.
 - (c) System events.
 - (d) Trends.
- b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
- c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.

2.06 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 - 1. User access secured via user passwords and user names.
 - 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 - 3. User Log On/Log Off attempts are recorded.
 - 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 - 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 - 1. Binary object is set to alarm based on the operator specified state.
 - 2. Analog object to have high/low alarm limits.
 - 3. All alarming is capable of being automatically and manually disabled.
 - 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
 - 1) Print.
 - 2) Custom messaging.
 - 3) Graphical displays.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. PID Control Characteristics:
 - 1. Direct or reverse action.
 - 2. Anti-windup.

3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.
- H. Staggered Start Application:
 1. Prevents all controlled equipment from simultaneously restarting after power outage.
 2. Order of equipment startup is user selectable.
- I. Energy Calculations:
 1. Accumulated instantaneous power or flow rates are converted to energy use data.
 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
 3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- J. Anti-Short Cycling:
 1. All binary output objects protected from short-cycling.
 2. Allows minimum on-time and off-time to be selected.
- K. On-Off Control with Differential:
 1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- L. Run-Time Totalization:
 1. Totalize run-times for all binary input objects.
 2. Provides operator with capability to assign high run-time alarm.

2.07 HVAC CONTROL PROGRAMS

- A. Optimal Run Time:
 1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
 2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
 3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
- B. Supply Air Reset:
 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.

2.08 CHILLER CONTROL PROGRAMS

- A. Control function of chilled water reset, and chiller sequencing. Support inch-pounds and SI (metric) units of measurement.
- B. Chilled Water Reset: Automatically reset controlled chilled water temperature satisfying cooling coil requiring greatest cooling.
- C. Chiller Sequencing: Determine which combination of chillers will most efficiently satisfy chilled water load, by cycling chillers, based on comparing load to switchover limits defined for each chiller.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.
- C. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide basic operator training on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

END OF SECTION 23 0923

**SECTION 23 0934
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 0529 - Hangers and Supports for HVAC Piping and Equipment.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.
- D. NEMA IS 10033 - Industrial Control and Systems: Adjustable-Speed Drives; 2026.
- E. NEMA IS 10034 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems; 2022 (Reapproved 2025).
- F. NEMA IS 10035 - Application Guide for AC Adjustable Speed Drive Systems; 2021 (Reaffirmed 2025).
- G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2023.
- H. NEMA MG 00001 - Motors and Generators; 2024.
- I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
 - 2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
 - 3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
 - 5. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 Sections for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include wiring diagrams showing factory and field connections.
- D. Derating Calculations: Indicate ratings adjusted for applicable service conditions.
- E. Specimen Warranty: Submit sample of manufacturer's warranty.
- F. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain copy of each referenced document that prescribes execution requirements at project site.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - 1. Authorized service facilities located within 200 miles of project site.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

1.09 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.
- B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.abb.com/#sle.
- B. Allen Bradley.
- C. Danfoss: www.danfoss.com/#sle.
- D. Eaton.
- E. Fuji.
- F. Schneider Electric Altivar.
- G. Yaskawa America, Inc; : www.yaskawa.com/#sle.
- H. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Variable-Frequency Motor Controller:
 - 1. Configuration: Packaged controller, nonbypass.
 - 2. Power Conversion System: IGBT-based active front end type.
 - 3. Control Method: Scalar/volts per hertz; open-loop, without feedback.
 - 4. Filtering: Provide input/line reactor and output/load reactor.
 - 5. Input/Output Connections: Refer to Drawings.
 - 6. Features:
 - a. PID control.
 - b. Firefighter's override.
 - c. Safety interlock.
 - d. Damper/valve control.
- D. Controller Assemblies: Comply with NEMA IS 10033, NEMA IS 10034, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- E. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA IS 10035, NEMA MG 00001 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
 - 1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 00001 design letter or inverter duty rating for induction motors.
 - 2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
 - 3. Motor nameplate data.
 - 4. Requirements for speed control range, speed regulation, and braking.
 - 5. Motor suitability for bypass starting method, where applicable.
- F. Single Controllers Serving Multiple Motors:
 - 1. Control Method: Scalar/volts per hertz; do not use vector control method.
 - 2. Provide separate overload relay for each motor; provide auxiliary contacts and control wiring as required to shut down controller upon trip of any single overload relay.
 - 3. Consider combined length of motor leads for cable length limits.
- G. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- H. Operating Requirements:
 - 1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
 - 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
 - 3. Efficiency: Minimum of 96 percent at full speed and load.
 - 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
 - 5. Overload Rating:
 - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
 - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- I. Power Conversion System: Microprocessor-based, pulse width modulation type.
- J. Control System:
 - 1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
 - 2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
 - 3. Control Functions:

- a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
 - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
 - 2) Vector Control: Provide selectable autotuning function.
 - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
 - c. Selectable braking control; DC injection or flux braking.
 - d. Adjustable minimum/maximum speed limits.
 - e. Adjustable pulse width modulation switching carrier frequency.
 - f. Adjustable motor slip compensation.
 - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
 - h. Automatic response to loss of speed reference; selectable to run motor at last known speed, run motor at designated speed, or stop motor.
 - i. PID Control: Provide integral PID controller employing feedback for closed-loop control where indicated or required.
 - j. Selectable frequency-skipping; minimum of three independently adjustable bands.
 - k. Automatic catching of rotating motor.
 - l. Energy-saving algorithms.
 - m. Firefighter's Override: Provide firefighter's override capability where indicated or required; upon activation of designated input, operate motor at designated speed without regard to noncritical faults and other inputs; operational in both drive and bypass modes where applicable.
 - n. Safety Interlock: Provide permissive run safety interlock capability where indicated or required; upon activation of designated input, stop and prevent operation of motor; operational in both drive and bypass modes where applicable.
 - o. Damper/Valve Control: Provide damper/valve control capability where indicated or required; upon receiving motor start command, activate designated damper/valve output and delay motor start until activation of designated end switch input confirms damper/valve operation.
4. Status Indications:
- a. Motor run/stop status.
 - b. Motor forward/reverse status.
 - c. Local/remote control status.
 - d. Output voltage.
 - e. Output current.
 - f. Output frequency.
 - g. DC bus voltage.
 - h. Motor speed.
 - i. Speed reference.
 - j. Elapsed run time.
 - k. Controller temperature.
 - l. Discrete input/output status.
 - m. Analog input/output values.
5. Protective Functions/Alarm Indications:
- a. Overcurrent.
 - b. Motor overload.
 - c. Undervoltage.
 - d. Overvoltage.
 - e. Controller overtemperature.
 - f. Input/output phase loss.
 - g. Output short circuit protection.

- h. Output ground fault protection.
 - i. Motor stalled/overtorque.
 - j. Motor underload.
 - k. External fault.
 - 6. Inputs:
 - a. Digital Input(s): Six.
 - b. Analog Input(s): Two.
 - 7. Outputs:
 - a. Analog Output(s): Two.
 - b. Relay Output(s): Three.
 - 8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
 - a. Serial Communications: RS-485; support for BACnet MS/TP protocol.
 - b. Ethernet Communications: Support for Modbus TCP and BACnet IP protocol.
 - c. Remote Monitoring Capabilities:
 - 1) Motor run/stop status.
 - 2) Hand-off-auto status.
 - 3) Fault information.
 - 4) Discrete input/output status.
 - 5) Analog input/output values.
 - d. Remote Control Capabilities:
 - 1) Motor run/stop command.
 - 2) Hand-off-auto selection.
 - 3) Speed adjustment.
 - 4) Fault reset.
 - 9. Features:
 - a. Password-protected security access.
 - b. Event log.
- K. Power Conditioning/Filtering:
 - 1. Provide DC link choke and input/line reactor for each controller unless otherwise indicated or required.
 - 2. Provide input surge protection.
 - 3. Reactor Impedance: 5 percent, unless otherwise indicated or required.
- L. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
 - 1. Disconnects: Circuit breaker or disconnect switch type.
 - a. Disconnect Switches: Fusible type with separate input fuses.
 - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 - 2. Provide door-mounted remote operator interface.
- M. Service Conditions:
 - 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
 - a. Altitude: Less than 3,300 feet.
 - b. Ambient Temperature: Between 0 degrees F and 122 degrees F.
 - 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- N. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.
 2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- O. Conductor Terminations: Suitable for use with conductors to be installed.
- P. Enclosures:
1. Comply with NEMA IA 10030.
 2. NEMA EN 10250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
 - b. Outdoor Locations: Type 3R or Type 4.
 3. Finish: Manufacturer's standard unless otherwise indicated.
 4. Cooling: Forced air or natural convection as determined by manufacturer.
 5. Enclosure Space Heaters:
 - a. Provide in each controller enclosure installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in enclosure or suitable external branch circuit as indicated or as required.
- Q. Interface with Other Work:
1. Provide products compatible with other systems requiring interface with controllers.
 2. Interface with building automation system.
 - a. Capable of remote monitoring and control of controllers.
- R. Products:
1. Basis-of-Design: ABB; ACH580: www.abb.com/#sle.

2.03 SOURCE QUALITY CONTROL

- A. Factory test controllers in accordance with NEMA ICS 61800-2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of controllers are consistent with indicated requirements.
- C. Verify that mounting surfaces are ready to accept controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA IS 10034 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 23 0529.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install field-installed devices, components, and accessories.

- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.07 PROTECTION

- A. Protect installed controllers from subsequent construction operations.

END OF SECTION 23 0934

**SECTION 23 1123
FACILITY NATURAL-GAS PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS

- A.
- B. Division 09, Exterior Painting.
- C. Division 09, Interior Painting.
- D. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- C. ANSI Z223.1 - National Fuel Gas Code; 2024.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.
- I. ASME B31.1 - Power Piping; 2024.
- J. ASME B31.9 - Building Services Piping; 2025.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- P. ASTM B813 - Standard Specification for Water Flushable Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2024.
- Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2023.
- R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- S. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- T. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- U. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- V. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

- W. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
 - 2. Joints: ASME B31.1, welded.
- B. Copper Tubing: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

2.02 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: ANSI Z223.1, welded.
 - 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Copper Tubing: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.

2.03 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Threaded or welded to ASME B31.1.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) or L (B) annealed.
 - 1. Fittings: ASME B16.26, cast bronze.
 - 2. Joints: Flared.
- C. Copper Tube: Listed, ASTM B88 (ASTM B88M), Type K (A), annealed.

1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.

2.04 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches and Under:
 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
 6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - a. Bases: High density polypropylene.
 - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 - e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
- B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 5. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.
 6. Other Types: As required.

2.06 BALL VALVES

- A. Manufacturers:
 1. Anvil International; [____]: www.anvilintl.com/#sle.
 2. Apollo Valves; _____: www.apollovalves.com/#sle.
 3. Crane Fluid Systems: <https://www.cranefs.com/>
 4. Flotite Valves and Controls: <https://flotite.com/>
 5. Jomar Valve: <https://www.jomarvalve.com/>
 6. Milwaukee Valve Company; _____: www.milwaukeevalve.com/#sle.
 7. Nibco: <https://www.nibco.com/>
 8. Mueller Streamline, Co; Series 7700: www.muellerstreamline.com/#sle.
 9. Watts: <https://www.watts.com/>
 10. Substitutions: See Division 01, Product Requirements.
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, brass, bronze, or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blowout proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

2.07 STRAINERS

- A. Size 2 inch and Under:
 - 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 - 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

2.08 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Manufacturers:
 - 1. Actaris Metering Systems (A brand of ITT Controls); _____: www.actaris-metering-systems.com/#sle.
 - 2. Dungs Combustion Controls; _____: www.dungs.com/#sle.
 - 3. Maxitrol Company; _____: www.maxitrol.com/#sle.
 - 4. Substitutions: See Division 01, Product Requirements.
- B. Compliance Requirements:
 - 1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
 - 2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
- C. Materials in Contact With Gas:
 - 1. Housing: Aluminum, steel (free of non-ferrous metals).
 - 2. Seals and Diaphragms: NBR-based rubber.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
 - 1. Painting of interior piping systems and components is specified in Division 09, Interior Painting.

2. Painting of exterior piping systems and components is specified in Division 09, Exterior Painting.
- M. Install valves with stems upright or horizontal, not inverted.
- N. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- P. Sleeve pipes passing through partitions, walls and floors.
- Q. Inserts:
 1. Provide inserts for placement in concrete formwork.
- R. Pipe Hangers and Supports:
 1. Install in accordance with ASME B31.9.
 2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 7. Provide copper plated hangers and supports for copper piping.
 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 9. Provide hangers adjacent to motor driven equipment with vibration isolation.

3.04 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.

3.05 SERVICE CONNECTIONS

- A. Upgrade the existing gas service complete with necessary upgrades to the gas meter and regulator as required for new boiler gas demand.

3.06 SCHEDULES

- A. Pipe Hanger Spacing:
 1. Metal Piping:
 - a. Pipe Size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum Hanger Spacing: 6.5 ft.
 - 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inches to 2 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inches to 3 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inches to 6 inches:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inches to 12 inches:

- 1) Maximum Hanger Spacing: 14 ft.
- 2) Hanger Rod Diameter: 7/8 inch.
- f. Pipe Size: 14 inches and Over:
 - 1) Maximum Hanger Spacing: 20 ft.
 - 2) Hanger Rod Diameter: 1 inch.

END OF SECTION 23 1123

**SECTION 23 2113
HYDRONIC PIPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Chilled water piping, buried.
- D. Chilled water piping, above grade.
- E. Equipment drains and overflows.
- F. Pipe hangers and supports.
- G. Unions, flanges, mechanical couplings, and dielectric connections.
- H. Valves:
 - 1. Pressure independent temperature control valves and balancing valves.
- I. Flow controls.

1.02 RELATED REQUIREMENTS

- A. Division 07, Firestopping.
- B. Division 09, Interior Painting.
- C. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
- D. Section 23 0523 - General-Duty Valves for HVAC Piping.
- E. Section 23 0553 - Identification for HVAC Piping and Equipment.
- F. Section 23 0719 - HVAC Piping Insulation.
- G. Section 23 2114 - Hydronic Specialties.
- H. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

- A. ANSI/FCI 70-2 - Control Valve Seat Leakage; 2021.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard; 2025.
- E. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250; 2024.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- H. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2025.
- I. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; 2021.
- J. ASME B31.9 - Building Services Piping; 2025.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- L. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2019a.
- M. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

- N. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014 (Reapproved 2020).
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.
- P. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- Q. ASTM B32 - Standard Specification for Solder Metal; 2020.
- R. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- S. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- T. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- U. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
- V. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2022.
- W. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2025.
- X. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe; 2006 (Reapproved 2012).
- Y. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.
- Z. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2024.
- AA. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2021a.
- BB. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).
- CC. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2024.
- DD. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- EE. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2025.
- FF. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2025.
- GG. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2024).
- HH. ASTM F2389 - Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems; 2023.
- II. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- JJ. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- KK. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- LL. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- MM. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- NN. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.
- OO. AWWA C606 - Grooved and Shouldered Joints; 2022.

- PP. DIN 4726 - Warm Water Surface Heating Systems and Radiator Connecting Systems - Plastics Piping Systems and Multilayer Piping Systems; 2017.
- QQ. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2025.
- RR. PPI TR-4 - PPI HSB Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe; 2024.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where indicated:

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2.03 CHILLED WATER PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black with AWWA C105/A21.5 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type with double layer, half-lapped polyethylene tape.
 - 2. Joints: Welded in accordance with AWS D10.12M/D10.12.
 - 3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A) annealed.
 - 1. Fittings: ASME B16.22, wrought copper.
 - 2. Joints: Solder, lead-free, ASTM B32 HB alloy (95-5 tin-antimony), or tin and silver.
 - 3. Casing: Polyurethane insulation with high density polyethylene jacket and heat shrink sleeves.

2.04 CHILLED WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2.05 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
 - 1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.06 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2.07 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches and Less:
 - 1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
 - 1. Ferrous Piping: 150 psig forged steel, slip-on.
 - 2. Copper Piping: Bronze.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Mechanical Couplings: Comply with ASTM F1476.

3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

2.08 PRESSURE INDEPENDENT TEMPERATURE CONTROL VALVES AND BALANCING VALVES

- A. Manufacturers:
1. Danfoss; _____: www.danfoss.com/#sle.
 2. Griswold Controls: <https://griswoldcontrols.com/>
 3. Hays Fluid Controls: <https://www.haysfluidcontrols.com/>
 4. Nexus: <https://nexusvalve.com/>
 5. Nibco: <https://www.nibco.com/>
 6. Victaulic Company; [_____]: www.victaulic.com/#sle.
 7. Xylem: <https://www.xylem.com/>
 8. Substitutions: Division 01, Product Requirements .
- B. Control Valves: Factory-fabricated pressure independent with internal differential pressure regulator (DPRV), which automatically adjusts to normal changes in system pressure and provides 100 percent control valve authority at all positions of the valve.
1. PICV to accurately control the flow from 0 to 100 percent full rated flow with an operating pressure differential range of 3 to 60 psig.
 2. Provide ANSI/FCI 70-2 Class 4 shut-off on all sizes and field serviceable.
 3. Provide control valve to incorporate control, balancing, and flow limiting. Hydronic system pressure independent control valve bodies to comply with ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure and have the following characteristics:
 - a. 2 NPS and Smaller: Class 150 bronze or brass body with union connections, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, and screwed ends with backseating capacity repackable under pressure.
 - b. 2-1/2 NPS and Larger: Class 125 iron or ductile iron body, stainless steel trim, stainless steel rising stem, stainless steel disc or ball, flanged ends with backseating capacity repackable under pressure.
 - c. Pressure Control Seat: Brass construction with vulcanized EPDM.
 - d. Sizing: Line-size.
 - e. Fittings and Components: All fittings and components to meet ANSI standards and be compatible with readily available components. 8-inch valves and above to be provided with proper companion flanges.
- C. Electronic Actuators: Direct-mounted, self-calibrating type designed for minimum 60,000 full-stroke cycles at rated force.
- D. Provide actuator with visible position indication. Fail positions on power failure to include in-place, open or closed as indicated in the controls specifications.

2.09 FLOW CONTROLS

- A. Manufacturers:
1. Anvil International; _____: www.anvilintl.com/#sle.
 2. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
 3. Griswold Controls; _____: www.griswoldcontrols.com/#sle.
 4. Hays Fluid Controls; _____: www.haysfluidcontrols.com/#sle.
 5. ITT Bell & Gossett; _____: www.bellgossett.com/#sle.
 6. Taco, Inc; _____: www.taco-hvac.com/#sle.
 7. Victaulic Company; _____: www.victaulic.com/#sle.
 8. Substitutions: Division 01, Product Requirements .
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

- C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified _____.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.
 - 1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
 - 2. Use flexible couplings in expansion loops.
- J. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
- K. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
 - 8. Prime coat exposed steel hangers and supports. See Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.

- M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- N. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Division 09.
- O. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
 - 7. 6 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
- B. Hanger Spacing for Steel Piping.
 - 1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.

END OF SECTION 23 2113

SECTION 23 2114 HYDRONIC SPECIALTIES

PART 2 PRODUCTS

1.01 EXPANSION TANKS

- A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible replaceable butyl bladder factory precharged to 12 psi, and steel support stand.
- B. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced-pressure-principle backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.
- C. Accessories: Provide air-charging fitting, bulls eye sight glass, pressure gauge, and tank drain ball valve.

1.02 AIR VENTS

- A. Manufacturers:
 - 1. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 2. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
 - 3. Flamco: www.flamcogroup.us/#sle.
 - 4. Taco, Inc; _____: www.taco-hvac.com/#sle.
 - 5. Substitutions: Division 01, Product Requirements.
- B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Air Vent:
 - 1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Maximum Fluid Pressure: 150 psi.
- E. Maximum Fluid Temperature: 250 degrees F.

1.03 AIR SEPARATORS

- A. Centrifugal Air Separators/Strainers:
 - 1. Primed steel body, tested and stamped in accordance with ASME BPVC-VIII-1 with integral bronze strainer, tangential flanged inlet and outlet connections, and internal stainless steel air collector tube.
 - 2. Maximum Service Flow and Pressure: 300 gpm at 125 psi.

1.04 STRAINERS

- A. Manufacturers:
 - 1. American Wheatley, a company of Global Flow Products, LLC; _____: www.wheatleyhvac.com/#sle.
 - 2. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
 - 3. Flexicraft Industries; _____: www.flexicraft.com/#sle.
 - 4. The Metraflex Company; LPD Y Strainer: www.metralflex.com/#sle.
 - 5. Substitutions: Division 01, Product Requirements.
- B. Size 2 inch and Under:
 - 1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.
- C. Size 2-1/2 inch to 4 inch:
 - 1. Provide flanged iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.

1.05 SUCTION DIFFUSERS

- A. Manufacturers:
 - 1. American Wheatley, a company of Global Flow Products, LLC; _____: www.wheatleyhvac.com/#sle.
 - 2. Anvil International; _____: www.anvilintl.com/#sle.
 - 3. Bell & Gossett, a brand of Xylem, Inc; _____: www.bellgossett.com/#sle.
 - 4. Shurjoint Piping Products, Inc; _____: www.shurjoint.com/#sle.
- B. Class 150, Size 1-1/2 to 4 inch:
 - 1. Angle-pattern flanged carbon steel fitted with integral vanes, removable strainer, and magnetic drain plugs for particle removal without disassembly.
 - 2. Maximum Operating Service:
 - a. Class 150: 150 psi at 450 degrees F.

1.06 COMBINATION PUMP DISCHARGE VALVES

- A. Quarter-Turn Plug Type: Flanged cast-iron body with bolt-on bonnet, position indicator, stainless steel stem, backflow preventer, memory stop, metering connectors, bubble-tight shutoff, and wrench-adjustable plug flow regulator.
- B. Triple-Duty Globe Type: Flanged cast-iron angle pattern body with bolt-on bonnet, position indicator, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, metering connectors, flow shutoff mechanism, and adjustable flow handle.

1.07 FLOW METERS

- A. Cast iron, wafer type, orifice insert flow meter for 250 psi working pressure, with read-out valves equipped with integral check valves with gasketed caps.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Install specialties and equipment in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- E. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- F. Provide valved drain and hose connection on strainer blowdown connection.
- G. Provide pump suction fitting on suction side of base-mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor-mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Pipe relief valve outlet to nearest floor drain.

END OF SECTION 23 2114

SECTION 23 2123 HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. In-line pumps.
- B. End-suction pumps.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 03, Cast-in-Place Concrete.
- C. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- D. Section 23 0716 - HVAC Equipment Insulation.
- E. Section 23 0719 - HVAC Piping Insulation.
- F. Section 23 0923 - Direct-Digital Control System for HVAC.
- G. Section 23 0934 - Variable-Frequency Motor Controllers for HVAC.
- H. Section 23 2113 - Hydronic Piping.
- I. Section 23 2114 - Hydronic Specialties.
- J. Division 25, Integrated Automation Instrumentation.
- K. Section 26 0583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 0101 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Electrical Requirements:
 - 1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
 - 2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 0934, except for integral-VFDs.
 - 3. Enclosures: Provide unspecified product(s) required to fit motor:

2.02 IN-LINE PUMPS

- A. Closed-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.
- B. Split-Coupled, Single-Stage Pump: Vertical pump with radially- or horizontally-split casing; rated for discharge pressures up to 175 psi.
- C. Casing: Cast iron with seal flush connection, flanged suction, and discharge ports with gauge port and drain plug.

- D. Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.
- E. Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.
- F. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.

2.03 END-SUCTION PUMPS

- A. Split-Coupled Pump: Base-mounted, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 175 psi.
- B. Close-Coupled Pump: Base-mounted, long-coupled, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 360 psi.
- C. Casing: Cast iron or ductile iron with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.
- D. Impeller: Bronze, balanced, fully enclosed, keyed to shaft.
- E. Bearings: Oil lubricated roller or ball bearings.
- F. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.
- G. Seal: Mechanical, 225 degrees F maximum continuous duty temperature.
- H. Drive: Flexible coupling with coupling guard.
- I. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- H. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. See Division 03.
- I. Lubricate pumps before start-up.
- J. Controls: Interface each pump starter or VFD with HVAC controller; see Section 23 0923.
- K. Controls Human-Machine Interface (HMI): HVAC operator terminal; see Section 25 3500.

END OF SECTION 23 2123

**SECTION 23 2500
HVAC WATER TREATMENT**

PART 2 PRODUCTS

1.01 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.

1.02 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
 - 2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
 - 2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.

1.03 BY-PASS (POT) FEEDER

- A. 2 quart quick opening cap for working pressure of 175 psi.

PART 3 EXECUTION

2.01 CLEANING SEQUENCE

- A. Concentration:
 - 1. As recommended by manufacturer.
- B. Hot Water Heating Systems:
 - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
 - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
 - 3. Circulate for 6 hours at design temperatures, then drain.
 - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems:
 - 1. Circulate for 48 hours, then drain systems as quickly as possible.
 - 2. Refill with clean water, circulate for 24 hours, then drain.
 - 3. Refill with clean water and repeat until system cleaner is removed.
- D. Remove, clean, and replace strainer screens.
- E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

2.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

2.03 CLOSED SYSTEM TREATMENT

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.

- C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

END OF SECTION 23 2500

**SECTION 23 3100
HVAC DUCTS AND CASINGS**

PART 2 PRODUCTS

1.01 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated.
- C. Duct Shape and Material in accordance with Allowed Static Pressure Range:
- D. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
 - a. Supply Air connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units: 1 in-wc pressure class, galvanized steel.
 - b. Supply Air connected to Constant Volume Air Handling Units: 2 in-wc pressure class, galvanized steel.
 - c. Supply Air connected to Variable Volume Air handling units out to terminal units: 4 pressure class, galvanized steel.
 - d. Outside Air Intake: 1 in-wc pressure class, galvanized steel.
 - e. Return and Relief Air: 1 in-wc pressure class, galvanized steel.
 - f. General Exhaust Air: 1 in-wc pressure class, galvanized steel.
 - g. Combustion Air: 1 in-wc pressure class, galvanized steel.
 - 2. Low Pressure Service: Up to 2 in-wc:
 - a. Seal: Class C, apply to seal off transverse joints.
 - b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
 - 2) Round: Class 12 or 12 cfm/100 sq ft.
 - 3. Low Pressure Service: From 2 in-wc to 3 in-wc:
 - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
 - b. Leakage:
 - 1) Rectangular: Class 12 or 12 cfm/100 sq ft.
 - 2) Round: Class 6 or 6 cfm/100 sq ft.
 - 4. Medium and High Pressure Service: Above 3 in-wc:
 - a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
 - b. Leakage:
 - 1) Rectangular: Class 6 or 6 cfm/100 sq ft.
 - 2) Round: Class 3 or 3 cfm/100 sq ft.
- E. Duct Fabrication Requirements:
 - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
 - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
 - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
 - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
 - 5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
 - 6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.

7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

1.02 METAL DUCTS

- A. Material Requirements:
 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
 2. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.
 3. Stainless Steel: ASTM A666, Type 304.
- B. Fire Rated Ducts:
 1. Two-hour, Fire Rated Duct:
 - a. UL labeled, construct of 18-gauge, 0.0516-inch galvanized steel.
 - b. R-Value: 4.5 when tested in accordance with ASTM C177.
- C. Connectors, Fittings, Sealants, and Miscellaneous:
 1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
 2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 4. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

1.03 FLEXIBLE DUCTS

- A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.
 1. Insulation: R6 insulation with polyethylene vapor barrier film.
 2. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
 3. Maximum Velocity: 5500 fpm.
 4. Temperature Range: Minus 20 degrees F to 250 degrees F.
- B. Acoustic Flexible Ducts: UL 181, Class 1, spunbond nylon, mechanically fastened and rolled using galvanized steel to form spiral helix.
 1. Insulation: Fiberglass insulation with metallic vapor barrier.
 2. Inner Core: Spunbonded, nonwoven inner core.
 3. Pressure Rating: 6 in-wc positive and 5 in-wc negative.
 4. Maximum Velocity: 4000 fpm.
 5. Temperature Range: Minus 20 degrees F to 250 degrees F.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream. Deviation from the 15 degree divergence shall be approved by the designer.
- F. Flexible Ducts: Connect to metal ducts with mechanical fastener.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal cap with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use double nuts and lock washers on threaded rod supports.
- K. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- L. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- M. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- N. Duct Insulation: Provide duct insulation. See Section 23 0713.

2.02 CLEANING

- A. Clean thoroughly each duct system. See Section 23 0130.51.
- B. Clean duct systems with high-power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access to the ductwork for cleaning purposes.

END OF SECTION 23 3100

**SECTION 23 3300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Barometric pressure relief dampers.
- D. Combination fire and smoke dampers.
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connectors.
- I. Smoke dampers.
- J. Volume control dampers.
- K. Air measuring control dampers.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 07, Firestopping.
- C. Section 23 3100 - HVAC Ducts and Casings.
- D. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- C. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026a.
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- G. NFPA 92 - Standard for Smoke Control Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- I. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- K. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- L. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- M. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

- N. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- O. UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- P. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

- A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 BAROMETRIC PRESSURE RELIEF DAMPER

- A. Damper provides pressure relief at differential pressure set points. Blades begin to open in parallel action when start-to-open pressure relief point is reached. Damper continues to open as pressure differential increases. Blades fully open once full-open pressure differential is reached.
- B. Mounting Orientation: As indicated on drawings.
- C. Frame Construction: Use galvanized steel, extruded aluminum, or stainless steel.
 - 1. Size: As indicated on drawings.
- D. Blade Construction: Use aluminum, galvanized steel, or stainless steel.
 - 1. Thickness Minimum: 0.025 inch.
 - 2. Axles: Use galvanized steel or stainless steel.
 - 3. Bearings: Use stainless steel, galvanized steel, or synthetic.
- E. Start-to-Open Pressure: As indicated on drawings. Start-to-open set point is adjustable.
- F. Pressure Opening Mechanism: Use counterbalance weight and spring-set. Adjustable in field.
- G. Pressure Drop Maximum: 0.02 in-wc.
 - 1. Measured at 500 fpm.

2.04 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Pottorff: www.pottorff.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.

4. Greenheck; <https://www.greenheck.com/>
 5. Substitutions: Division 01, Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labeled; spring-return, electric-type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.05 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Access doors with sheet metal screw fasteners are not acceptable.

2.06 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 FIRE DAMPERS

- A. Manufacturers:
1. Nailor Industries, Inc: www.nailor.com/#sle.
 2. Pottorff: www.pottorff.com/#sle.
 3. Ruskin Company: www.ruskin.com/#sle.
 4. Greenheck; <https://www.greenheck.com/>
 5. Substitutions: Division 01, Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling (Radiation) Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame and 16-gauge, 0.0598-inch flap, two layers of 0.125-inch thick ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
1. Rated for three hour service in compliance with UL 555C.
 2. Manufacturers:
 - a. Nailor Industries, Inc; www.nailor.com/#sle.
 - b. Pottorff: www.pottorff.com/#sle.
 - c. Ruskin Company: www.ruskin.com/#sle.
 - d. Greenheck; <https://www.greenheck.com/>
- D. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.
- F. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.08 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd.

2.09 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Pottorff: www.pottorff.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Greenheck; <https://www.greenheck.com/>
 - 5. Substitutions: Division 01, Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.10 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Nailor Industries, Inc: www.nailor.com/#sle.
 - 2. Pottorff: www.pottorff.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Greenheck; <https://www.greenheck.com/>
 - 5. Substitutions: Division 01, Product Requirements.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers:
 - 1. Fabricate for duct sizes up to 6 by 30 inch.
 - 2. Blade: 24 gauge, 0.0239 inch, minimum.
- D. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch, minimum.
- E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- F. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.11 AIR MEASURING CONTROL DAMPERS

- A. Manufacturers
 - 1. Ebtron, Inc: www.ebtron.com/#sle.
 - 2. Greenheck Fan Corporation: www.greenheck.com/#sle.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Substitutions: Division 01, Product Requirements.
- B. Factory-Mounted Assembly Requirements:
 - 1. Damper Unit or Multi-Unit:

- a. Construction: Flanged-to-duct frame made of extruded aluminum with V or 3V blades for low to medium pressure applications, zinc-plated steel hardware, frame-mounted shaft bearings, frame-assembly sleeve, and silicone seals at frame and blade ends.
- b. Control: Opposed blade modulation by damper actuator(s) from air measuring sensor transmitter-controller unit.
- 2. Air Measuring Sensor Transmitter-Controller:
 - a. Transmitter: Five percent accuracy, adjustable zero and span, 10 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.
 - b. Controller: Configure to control hardware-linked damper actuator(s) based on locally typed or software-defined setpoint. Access for user to do local or remote proportional, integrative, and derivative control-loop tuning.
 - c. Hardwired External Damper Actuator Output: Two-wire, 4 to 20 mA.
 - d. BTU Metering: Provide temperature sensor for field mounting upstream or downstream of heating or cooling source.
- 3. Damper Actuator(s), Factory-Installed:
 - a. Motor: Maintenance-free brushless DC powered, selectable clock wise (CW) counter-clock wise (CCW) direction, 60 second stroke, and adjustable mechanical end stops within 95-degree stroke range.
 - b. Actuator Type: Modulated operation using incoming input signal with electronic overload protection, double-insulated electrical protection, and fail-safe control using built-in energy storage battery for return under 20 seconds.
 - c. Position Feedback: 0 to 5 VDC signal wired into transmitter-controller.
- C. Service Temperature Range: Minus 20 to 160 degrees F.
- D. Enclosure Rating for Transmitter-Controller and Damper Actuator(s):
 - 1. General: UL 50 or UL 50E listed for use in non-hazardous locations.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.

- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- J. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.
- K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.
- L. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 23 3300

**SECTION 23 3700
AIR OUTLETS AND INLETS**

PART 2 PRODUCTS

1.01 ROUND CEILING DIFFUSERS

- A. Type: Round, adjustable pattern, stamped or spun, multicore diffuser to discharge air in 360-degree pattern, with sectorizing baffles where indicated. Project diffuser collar not more than 1 inch above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.
- B. Fabrication: Steel with baked enamel finish.
- C. Color: As selected by Engineer/Architect from manufacturer's standard range.
- D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

1.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- B. Fabrication: Steel with baked enamel finish.
- C. Color: As selected by Engineer/Architect from manufacturer's standard range.

1.03 PERFORATED FACE CEILING DIFFUSERS

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Fabrication: Steel with steel frame and baked enamel finish.
- C. Color: As selected by Engineer/Architect from manufacturer's standard range.

1.04 CEILING SLOT DIFFUSERS

- A. Type: Continuous 1/2 inch wide slot, 1 slots wide, with adjustable vanes for left, right, or vertical discharge; integral ceiling fire damper.
- B. Fabrication: Aluminum extrusions with factory clear lacquer finish.
- C. Color: To be selected by Engineer/Architect from manufacturer's standard range.
- D. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket, mitered end border.
- E. Plenum: Integral, galvanized steel, insulated.

1.05 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

- A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- B. Material: 22 gauge, 0.0299 inch.

1.06 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Construction: Made of aluminum extrusions with factory enamel finish.
- D. Color: As selected by Engineer/Architect from manufacturer's standard range.

1.07 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.

- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Engineer/Architect from manufacturer's standard range.

1.08 CEILING LINEAR EXHAUST AND RETURN GRILLES

- A. Type: Streamlined blades with 90 degree one-way deflection, 1/8 by 3/4 inch on 1/4 inch centers.
- B. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- C. Color: To be selected by Engineer/Architect from manufacturer's standard range.

1.09 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

- A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.
- B. Fabrication: Grid core consists of aluminum with mill aluminum finish.
- C. Color: To be selected by Engineer/Architect from manufacturer's standard range.
- D. Frame: 1-1/4 inch margin with countersunk screw mounting.
- E. Accessories: Provide integral gang and face operated opposed blade damper, 2 inch filter frame, plaster frame, square mesh insect screen, square mesh debris screen, prescored molded fiberglass back, and 45 degree angled eggcrate or other similar provisions for visual blocking such as angled louver or 90 degree duct elbow.

1.10 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Engineer/Architect from manufacturer's standard range.

1.11 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Engineer/Architect from manufacturer's standard range.

1.12 LINEAR WALL REGISTERS/GRILLES

- A. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Engineer/Architect from manufacturer's standard range.

1.13 LOUVERS

- A. Type: 6 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.
- B. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.
- C. Color: To be selected by Architect from manufacturer's standard range.

1.14 ROOF HOODS

- A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).
- B. Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch base and 20 gauge, 0.0359 inch hood, or aluminum, minimum 16 gauge, 0.0598 inch base and 18 gauge, 0.0598 inch hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.
- C. Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

1.15 GRAVITY VENTILATORS

- A. Hood Intake and Relief Gravity Ventilator:
 - 1. General:
 - a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
 - b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
 - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 2. Hood and Base:
 - a. Hood Construction: Precision formed, arched panels with interlocking seams.
 - b. Vertical End Panels: Fully locked into hood end panels.
 - 3. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
- B. Spun Aluminum Intake and Relief Gravity Ventilator:
 - 1. General:
 - a. Provide low silhouette configuration for intake applications with natural gravity or negative pressure system.
 - b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
 - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
 - 2. Birdscreen:
 - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
 - 3. Options/Accessories:
 - a. Roof Curbs:
 - 1) Flat Roofs:
 - (a) Welded, straight side curb with flashing flange and wood nailer.
 - (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
 - (c) Welded curb with 45 degree cant and wood nailer.
 - 2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
 - 3) Mounted upon roof with fan.
 - 4) Material: Aluminum.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- D. Install diffusers to ductwork with air tight connection.

- E. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- F. Paint ductwork visible behind air outlets and inlets matte black, see Division 09.

2.02 PROTECTION

- A. Protect installed products until completion of project.
- B. Replace, repair, or touch-up damaged products before Substantial Completion.

END OF SECTION 23 3700

**SECTION 23 4000
HVAC AIR CLEANING DEVICES**

PART 2 PRODUCTS

1.01 FILTER MANUFACTURERS

- A. American Air Filter Company, Inc; _____: www.aafintl.com/#sle.
- B. Camfil, a company of The Camfil Group; _____: www.camfil.us/#sle.
- C. Glasfloss: www.glasfloss.com.
- D. Substitutions: Division 01, Product Requirements.

1.02 PERFORMANCE REQUIREMENTS

- A. Comply with the rating requirements in AHRI 850 (I-P).

1.03 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
- B. Casing: Cardboard frame.

1.04 FILTER GAUGES

- A. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 to 0.5 in-wc, 2 percent of full scale accuracy.
- B. Inclined Manometer: One piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0 to 3 in-wc, 3 percent of full scale accuracy.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set

END OF SECTION 23 4000

**SECTION 23 5100
BREECHINGS, CHIMNEYS, AND STACKS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Type B double wall gas vents.
- B. Double wall metal stacks.
- C. Special gas venting.

1.02 RELATED REQUIREMENTS

- A. Division 07, Firestopping.
- B. Section 23 0716 - HVAC Equipment Insulation.
- C. Section 23 0719 - HVAC Piping Insulation.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.66 - Automatic Damper Devices for Use with Gas-Fired Appliances; 2023.
- B. NFPA 54 - National Fuel Gas Code; 2024.
- C. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2024.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- E. UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.
- F. UL 1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory-built units are used.

PART 2 PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

- A. Regulatory Requirements:
 - 1. Comply with applicable codes for installation of natural gas burning appliances and equipment.

2.02 TYPE B DOUBLE WALL GAS VENTS

- A. Use only the vent materials, systems, and manufactures as approved by the boiler manufacturer.
- B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.
- C. Electrically Actuated Vent Dampers: Same size as draft hood collar, constructed of stainless steel or galvanized steel, with corrosion-resistant components, in compliance with ANSI Z21.66.

2.03 SPECIAL GAS VENTING (CATEGORY II, III, AND IV)

- A. Single-Wall Special Gas Venting:
 - 1. Use only the vent materials, systems, and manufactures as approved by the boiler manufacturer.

2. Provide single-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
 3. Fabricate with 28-gauge, 0.0156-inch 29-4C stainless steel minimum.
 4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.
 5. Accessories, UL Labeled:
 - a. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
 - b. Exit Cone: Consists of inner cone and outer jacket to increase stack exit velocity 1.5 times.
 - c. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.
- B. Double-Wall Special Gas Venting:
1. Use only the vent materials, systems, and manufactures as approved by the boiler manufacturer.
 2. Provide double-wall metal stacks, tested to UL 1738 and UL listed with positive pressure rating for use with building heating equipment; comply with NFPA 54.
 3. Fabricate with 1-inch minimum air space between walls and construct inner liner of 28-gauge, 0.015-inch 29-4C stainless steel minimum and outer jacket of 24 gauge, 0.025-inch stainless steel minimum.
 - a. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
 4. Design, fabricate, and install gastight to prevent products of combustion from leaking into building. Securely connect inner joints and seal in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54
- C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- D. Rigidly support breechings from building structure with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12-foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- E. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified Division 07.
- G. For Type B, double-wall gas vents, maintain UL-listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- H. Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- I. Level and plumb chimney and stacks.
- J. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- K. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

END OF SECTION 23 5100

SECTION 23 5216 CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.02 RELATED REQUIREMENTS

- A. Section 23 2114 - Hydronic Specialties.
- B. Section 23 2123 - Hydronic Pumps.
- C. Section 23 2500 - HVAC Water Treatment.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- F. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.02 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.

- D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.
- E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.03 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
 - 3. Air pressure.
- F. Manual reset high limit.
- G. Boiler Pump (where required by boiler design):
 - 1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.
 - 2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.
 - 3. Pump time delay.

2.04 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
 - 1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 - 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 - 3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.
 - 4. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.05 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
 - 1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
 - 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 - 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.

- D. Microprocessor-based, fuel/air mixing controls.

END OF SECTION 23 5216

**SECTION 23 6423
SCROLL WATER CHILLERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air-cooled scroll water chillers.

1.02 RELATED REQUIREMENTS

- A. Division 03 Cast-in-Place Concrete: Concrete housekeeping pads.
- B. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 23 2113 - Hydronic Piping.
- D. Section 23 2114 - Hydronic Specialties.
- E. Section 26 0583 - Wiring Connections.

1.03 REFERENCE STANDARDS

- A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle; 2023.
- B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Errata (2025).
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASHRAE Std 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks; 2024, with Errata (2026).
- E. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .
- F. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- G. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 AIR-COOLED, SCROLL WATER CHILLER

- A. Factory assembled and tested chiller consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, starters, and microprocessor-based controls.
 - 1. Rating: AHRI 550/590 (I-P).
 - 2. Safety: UL 1995 and ASHRAE Std 15.
 - 3. Construction and Testing: ASME BPVC-VIII-1 as applicable for construction type.
 - 4. Energy Efficiency: ASHRAE Std 90.1.
 - 5. Enclosures:
 - a. Frame: Heavy-gauge steel with hot-dipped galvanized or air-dried paint finish.
 - b. Steel Cabinets: Factory apply baked on enamel or baked on powder paint finish.
 - c. Perform 500-hour minimum salt spray test in accordance with ASTM B117.
- B. Hermetic Scroll Compressor:
 - 1. Unit: Fully hermetic type with multiple, direct drive compressors with discharge and suction service valves.
 - 2. Vibration Control: Factory installed internal isolators or field installed external isolators.
 - 3. Oil Lubrication System: Initial oil charge, oil sump, heater, oil level, and sight glass.
 - 4. Capacity Reduction System: Compressor staging with control down to 12 percent of full load without the activation of hot gas bypass.
 - 5. Motor: 3600 or 3500 rpm, suction gas-cooled, with thermal or current overload protection.
- C. Evaporator:

1. Brazed plate type.
 - a. Plate Material: 316 stainless steel.
 - b. Working Pressure Rating, Refrigerant Side: 430 psi minimum.
 - c. Working Pressure Rating, Water Side: 150 psi minimum.
 - d. End Connections: Provide with flanged or grooved connections.
 - e. Cold Surface Insulation.
 - 1) Insulation is factory or field installed on evaporator, connections, and suction piping.
 - 2) 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum K factor of 0.28.
 - f. Provide factory installed vents and water drain connections on evaporator or piping.
 - g. Provide factory installed fittings for temperature control sensors on evaporator or piping.
 - h. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.
- D. Air-Cooled Condenser, Finned-Tube Type:
 1. Finned-Tube Type:
 - a. Mechanically bond aluminum fins to copper tubing and protect with corrosion resistant materials or coatings.
 - b. Clean, dehydrate and test.
 - c. Leak Test: 650 psi minimum.
 2. Coil Guards: Provide corrosion proof, louvered panels, heavy gauge wire panels, or grilles, factory installed. Protect condenser coil by enclosing with heavy plastic to prevent damage during shipping or rigging.
 3. Fans and Motors:
 - a. Fans: Dynamically balance propeller, shrouded-axial, or airfoil type fans of reinforced polymer or glass fiber reinforced composite corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
 - b. Discharge Fan Guards: Corrosion resistant, heavy gauge, steel wire.
 - c. Discharge Direction: Vertical.
 - d. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.
- E. Refrigerant Circuits:
 1. Provide multiple independent refrigeration circuits with one or multiple compressor(s) per circuit.
 2. Provide liquid line shut-off valve, filter-drier, expansion valve, and refrigerant relief device for each independent circuit.
- F. Controls Package:
 1. Unit Controls: Factory-supplied DDC:
 - a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.
 - b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.
 - c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.
 - d. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
 - e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
 - f. Isolation Valves: Field-installed, 2-position, butterfly type with position tracking.

2. Prewire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starters, disconnect switches, power and control wiring. Provide controls, monitoring, programmable setpoints, alarms, and BAS as defined below:
 - a. Automatic Adjustable Operating Controls:
 - 1) Temperature of chilled water leaving chiller.
 - 2) Chiller system capacity control based on setpoints and system load.
 - 3) Compressor short-cycling prevention.
 - 4) Lead/lag for multiple compressors.
 - 5) Automatic reset on power source failure.
 - 6) Load limiting.
 - b. Normal Operation Monitoring and Open Coverless Displays:
 - 1) Hours of operation.
 - 2) Suction and discharge refrigerant pressures.
 - 3) Automatic diagnostics.
 - 4) Number of starts.
 - 5) On/off compressor status.
 - 6) Entering and leaving chilled water temperatures.
 - 7) Status of operation.
 - 8) Condenser water entering and leaving temperatures.
 - 9) Weekly purge cycle totalization if applicable.
 - 10) Oil pressure.
 - c. Setpoints:
 - 1) Leaving chilled water temperature.
 - 2) Date/time.
 - d. Automatic Chiller Shut-Down Safety Controls and Alarm:
 - 1) Automatic Reset:
 - (a) Chilled water flow interlock.
 - (b) Voltage protection; over and under.
 - (c) Phase reversal protection.
 - 2) Manual Reset:
 - (a) Evaporator low pressure.
 - (b) High motor winding temperature.
 - (c) Low chilled water temperature.
 - (d) Low chilled water flow.
 - (e) High condenser refrigerant discharge pressure.
 - (f) Motor current overload and phase loss.
 - (g) Low oil flow.
 - 3) Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
 - e. Points for Remote Monitoring and Control:
 - 1) Minimum Data Transmission to BAS:
 - (a) All system operating conditions.
 - (b) Capacity control information.
 - (c) Safety shutdown conditions.
 - 2) Minimum Operating Commands from BAS:
 - (a) Remote unit start/stop.
 - (b) Remote chilled water reset.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.

- C. Install units on vibration isolators.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.
- B. Supply initial charge of refrigerant and oil if not completely factory charged.
- C. Demonstrate system operations and verify specified performance.

END OF SECTION 23 6423

**SECTION 23 7433
DEDICATED OUTDOOR AIR UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof-mounted DOAS.
- B. Controls.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0934 - Variable-Frequency Motor Controllers for HVAC.
- D. Section 23 1123 - Facility Natural-Gas Piping: Natural gas connections.
- E. Section 23 3300 - Air Duct Accessories: Flexible duct connections.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 270 (SI/I-P) - Sound Performance Rating of Outdoor Unitary Equipment; 2025.
- C. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 54 - National Fuel Gas Code; 2024.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL (DIR) - Online Certifications Directory; Current Edition.
- H. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. CaptiveAire Systems; _____: www.captiveaire.com/#sle.
- B. Greenheck; _____: www.greenheck.com/#sle.
- C. Trane: www.trane.com.
- D. Daikin Applied: www.daikinapplied.com

2.02 ROOF-MOUNTED DOAS

- A. Packaged Unit:
 - 1. Casing and Components:
 - a. Fabrication: AHRI 210/240 and UL 207 construction, ASHRAE Std 23 tested.
 - b. 18 gauge, 0.0478 inch steel panels reinforced with structural angles and channels to ensure rigidity.
 - c. Provide bolted access panels to access each sections from either side of unit.
 - d. Provide hinged door with lockable handle for serviceable sections.
 - e. Drain Pan: Galvanized steel with corrosion-resistant coating.
 - 2. Performance Ratings: ASHRAE Std 90.1, EER and COP as applicable.
 - 3. Regulatory Requirements: AHRI 270 (SI/I-P) rated, NFPA 70, and UL (DIR) listed.

4. Insulation: 2 inch foam injected R-13 panels with thermal break.
5. External Surface Finish: Heat resistant baked enamel.
6. Outdoor Installation: Weatherproofed casing, with intake louver or hood.
7. Outside Air Damper with Rain Hood and Screen:
 - a. Set outdoor air dampers to fully open when fan starts and close 30 seconds after fan stops, adjustable.
- B. Filter Section:
 1. Filter: Removable, 2 inches thick MERV-8.
- C. Heating Section:
 1. Hot Water Coil:
 - a. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- D. Cooling Section:
 1. Chilled Water:
 - a. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
 - b. Provide capillary tubes or thermostatic expansion valves for units of 6 Tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 Tons cooling capacity and larger.
- E. Fan Section:
 1. Provide direct or plenum mounted variable-speed fan motors; see Section 23 0513.
 2. Draw-through, forward-curved fan, constructed of corrosion-resistant, galvanized material and designed for efficient, quiet operation.
 3. Factory program for both soft start and constant flow output over static pressure range.
 4. Provide preinstalled neutral wire protection when required to support specified fan type.
 5. Motor to include thermal overload protection, quick disconnect plug, and permanently lubricated bearings.
 6. Belt-Driven Motor Requirements: Provide adjustable blower motor/sheave combination device based on indicated flow performance requirements. Statically and dynamically balanced centrifugal fan mounted on solid steel shaft with heavy-duty, self-aligning, pre-lubricated ball bearings and V-belt drive with matching motor sheaves and belts.
 7. Variable Speed Control: Configure controller to maintain adjustable flow setpoint for modulating or speed-switched units; see Section 23 0934.
 8. Fan Turndown: Design control features to allow fan speed reduction to adjustable 50 percent of its capacity when the zone set point temperature is satisfied or when unit runs in fan-only mode.
- F. Unit Controls:
 1. DDC:
 - a. Application Specific Controller.
 - b. Tested to monitor and handle sequencing functions and other operational modes using field-mounted thermostat and other sensors.
 - c. Coordination and Sequencing:
 - 1) Internal Devices: Include compressors, blower, sensors, switches, valves, safeties, other components.
 - 2) Field-Installed Devices: Solenoid valves, thermostat, EWT sensors, LWT sensors, internal and remote contacts, and other devices required for operation.
 - 3) Safeties: At minimum include anti-short-cycle compressor protection, condensate overflow, refrigerant high pressure, refrigerant low pressure, loss-of-charge, refrigerant freeze protection, and freezestat.
 2. Thermostat:
 - a. Field mounted and wired, tied into prewired control-interface terminals.
 - b. Smart Thermostat:

- 1) BAS, SCADA, or Integrated Automation linked programmable thermostat.
3. Airflow Meter:
 - a. Include integral airflow meter station or probe for ventilation, supply, or exhaust airflow in cfm as indicated on drawings.
4. Local Control Panel: Interface to include on-off-auto switch, summer-winter switch, heat-off-cool switch, indicating lights for supply fan, pilot operation, burner operation, lockout indication, and clogged filter indication.
5. Interlocked Functions:
 - a. Unit to start when exhaust fan is running.
 - b. Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded. Include manual reset switch.
 - c. Burner Safety Controls:
 - 1) Sense correct airflow before energizing pilot and sense pilot ignition before activating main gas valve.
 - 2) Burner to operate when flow switch located in exhaust duct proves flow. Exhaust fan speed control with inlet damper and burner profile damper to provide dual volume air capacity.
 - 3) Purge Period Timer: Automatically delays burner ignition and bypass low limit control.
- G. Electrical: 480 VAC, 3-phase, 60 Hz, single point to factory-mounted non-fused disconnect switch internally wired into motors and compressors, and other powered components including system safeties.
- H. Furnish dedicated outdoor air unit and associated components and accessories produced by a single manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Follow NFPA 54 guidelines to provide natural gas system connection; see Section 23 1123.
- C. Install unit on vibration isolator pad or roof curb.
- D. Provide flexible duct connections on inlet and outlet from unit; see Section 23 3300.
- E. Connect drain pan outlet to nearest building drain system piping.
- F. Adjusting: Use plenum static pressure readings against manufacturer calibration chart to adjust primary airflow as other measuring methods will not work.
- G. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote.

END OF SECTION 23 7433

**SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fan-coil units.

1.02 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0716 - HVAC Equipment Insulation.
- C. Section 23 0719 - HVAC Piping Insulation.
- D. Section 23 2113 - Hydronic Piping.
- E. Section 23 2114 - Hydronic Specialties.
- F. Section 23 3100 - HVAC Ducts and Casings.

1.03 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.04 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

PART 2 PRODUCTS

2.01 FAN-COIL UNITS

- A. Performance Data and Safety Requirements:
 - 1. Unit capacities certified in accordance with AHRI 440.
 - 2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
 - 3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
 - 4. Equipment wiring to comply with requirements of NFPA 70.
- B. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).
- C. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
 - 2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
 - 3. Provide drain pan under cooling coil easily removable for cleaning.
- D. Vertical Cabinet and Horizontal Exposed Units: Minimum 18 gauge, 0.0478 inch thick sheet steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
- E. Horizontal Recessed Units:

1. Provide with a galvanized steel cabinet, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles with minimum 18 gauge, 0.0478 inch thick sheet steel bottom panel.
 2. Ducted Units: Provide with air inlet and outlet duct collars.
- F. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.
- G. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- H. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- I. Controls:
1. Provide units with control valves furnished by the automatic temperature controls manufacturer.
- J. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Fan-Coil Units:
 1. Install as indicated.
 2. Coordinate to ensure correct recess size for recessed units.

3.03 CLEANING

- A. See Division 01, Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- E. Install new filters.

END OF SECTION 23 8200

**SECTION 26 0505
SELECTIVE DEMOLITION FOR ELECTRICAL**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

1.02 RELATED REQUIREMENTS

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

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Engineer/Architect before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical and Auxiliary Systems: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling affected systems.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

END OF SECTION 26 0505

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2024.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- I. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer/Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
- H. Manufactured wiring systems are not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 - 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Travelers for 3-Way and 4-Way Switching: Pink.
 - e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
 - f. For control circuits, comply with manufacturer's recommended color code.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.

- b. Size 8 AWG and Larger: Stranded.
- 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN-2.
 - a. Installed Underground: Type XHHW-2.
 - b. Variable-frequency drive (VFD) Circuits: Distance between VFD and associated motor:
 - 1) Less than 100 feet: Type XHHW-2. Do not share conduit with other circuits.

2.04 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 - 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 - 6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 - 7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.05 ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.

2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
 6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant:
1. Listed and labeled as complying with UL 267.
 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 6. Circuiting Adjustments: Unless otherwise indicated, when 20A single-phase branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same

raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 - 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 - 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Install conductors with a minimum of 12 inches of slack at each outlet.
- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.

- b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
- 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
- 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Identify conductors and cables in accordance with Section 26 0553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for conductors larger than 6 AWG. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.
- E. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2025.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Field quality control test reports.
- E. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer/Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method or alternate test described in IEEE 81.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 3. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground access well for first connected electrode.
 - 4. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 - 5. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

- G. Service-Supplied System Grounding:
 - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - 2. Provide grounding electrode conductor to connect derived system grounded conductor to common grounding electrode conductor ground riser. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
 - 3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 - 4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 - 5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 - 6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- I. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.

- 2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.
- C. Connectors for Grounding and Bonding:
 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. Harger Lightning & Grounding; _____: www.harger.com/#sle.
 - c. nVent ERICO; _____: www.nvent.com/#sle.
 - d. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. nVent ERICO; Cadweld: www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC; _____: www.thermoweld.com/#sle.
- D. Ground Rod Electrodes:
 1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
 5. Manufacturers:
 - a. Galvan Industries, Inc; _____: www.galvanelectrical.com/#sle.
 - b. Harger Lightning & Grounding; _____: www.harger.com/#sle.
 - c. nVent ERICO; _____: www.nvent.com/#sle.
- E. Ground Access Wells:
 1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 4. Cover: Factory-identified by permanent means with word "GROUND".
 5. Manufacturers:
 - a. Harger Lightning & Grounding: www.harger.com/#sle.
 - b. nVent ERICO: www.nvent.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.

- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

**SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section Division 03.

1.05 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of 25 percent. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 - 3. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
- D. Metal Channel/Strut Framing Systems:
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - c. Eaton Corporation: www.eaton.com/#sle.
 - 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 3. Comply with MFMA-4.
 - 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel or zinc-plated steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 6. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2-inch diameter.
 - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
 - e. Outlet Boxes: 1/4-inch diameter.
 - f. Luminaires: 1/4-inch diameter.
- F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 1. Manufacturers:
 - a. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Green Link, Inc: www.greenlinkengineering.com/#sle.
 - d. PHP Systems/Design: www.phpsd.com/#sle.
 2. Description: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- G. Anchors and Fasteners:
 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 6. Hollow Masonry: Use toggle bolts.
 7. Hollow Stud Walls: Use toggle bolts.
 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 9. Sheet Metal: Use sheet metal screws.
 10. Wood: Use wood screws.
 11. Plastic and lead anchors are not permitted.
 12. Powder-actuated fasteners with lock nuts and washers are permitted only as follows:
 - a. May be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - b. Use only threaded studs; do not use pins.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Engineer/Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Engineer/Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized concrete pad 4 inches in height; see Section Division 03.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment: See Section 26 0533.13 for additional requirements.
- I. Box Support and Attachment: See Section 26 0533.16 for additional requirements.
- J. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.
- K. Secure fasteners in accordance with manufacturer's recommended torque settings.
- L. Remove temporary supports.
- M. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

**SECTION 26 0533.13
CONDUIT FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Galvanized steel electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2025.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2025.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- H. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- K. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- L. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- M. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- N. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- O. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- P. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
 5. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.05 SUBMITTALS

- A. See Division 01 for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

1.06 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows for bends.
 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use factory-applied corrosion protection coating acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
 2. Within Slab Above Ground: Not permitted.
- E. Concealed Within Masonry Walls: Use galvanized steel electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel electrical metallic tubing (EMT).

- G. Concealed Above Accessible Ceilings: Use galvanized steel electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
- L. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
 - 1. Exterior locations subject to severe physical damage include, but are not limited to:
 - a. Where exposed to vehicular traffic below 20 feet.
- M. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- N. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 3 feet unless otherwise indicated.
 - 4. Minimum Length: 2 feet unless otherwise indicated.
 - 5. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
 - c. HVAC equipment.
- O. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC).

2.02 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch trade size.
 - 3. Control Circuits: 1/2-inch trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch trade size.
 - 5. Underground, Interior: 3/4-inch trade size.
 - 6. Underground, Exterior: 1-inch trade size.
- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Robroy Industries.
 - 4. Rymco USA: www.rymcousa.com/#sle.
 - 5. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 6. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.

- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - e. Picoma Industries.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Anamet Electrical.
 - 3. Electri-Flex Company: www.electriflex.com/#sle.
 - 4. International Metal Hose: www.metalhose.com/#sle.
 - 5. Southwire Company.
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Anamet Electrical.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Anamet Electrical.
 - 3. Electri-Flex Company: www.electriflex.com/#sle.
 - 4. International Metal Hose: www.metalhose.com/#sle.
 - 5. Southwire Company.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Anamet Electrical.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.06 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular/#sle.
 - 3. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 4. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use compression/gland type.
 - a. Do not use indenter type connectors and couplings.
 - b. Do not use set-screw type connectors and couplings.
 - 5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

2.07 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. ABB; Carlon: www.carlon.com/#sle.
 - 2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 3. Cantex Inc: www.cantexinc.com/#sle.
 - 4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
 - 5. JM Eagle: www.jmeagle.com/#sle.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.08 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Foam Conduit Sealant:
 - 1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Rated to hold minimum of 10 ft water head pressure.
- E. Sealing Systems for Concrete Penetrations:

1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- E. Conduit Routing:
 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 2. When conduit destination is indicated without specific routing, determine exact routing required.
 3. Conceal conduits unless specifically indicated to be exposed.
 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 5. Unless otherwise approved, do not route exposed conduits:
 - a. Across floors, slabs, or grade.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 9. Arrange conduit to provide no more than 150 feet between pull points.
 10. Route conduits above water and drain piping where possible.
 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 14. Group parallel conduits in same area on common rack.
- F. Conduit Support:
 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
 8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
 9. Use of wire for support of conduits is not permitted.
 10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- G. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
 7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
 8. Secure joints and connections to provide mechanical strength and electrical continuity.
- H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 4. Conceal bends for conduit risers emerging above ground.
 5. Provide suitable sealing system where conduits penetrate exterior wall below grade.
 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
 8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Division 07.
- I. Underground Installation:
1. Provide trenching and backfilling; see Civil Drawings.
 2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Comply with NFPA 70 Article 300 requirements.
 3. Provide underground warning tape along entire conduit length; see Section 26 0553.

- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 3. Where conduits are subject to earth movement by settlement or frost.
- K. Conduit Sealing:
 - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - a. Where conduits enter building from outside.
 - b. Where service conduits enter building from underground distribution system.
 - c. Where conduits enter building from underground.
 - d. Where conduits may transport moisture to contact live parts.
 - 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- L. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- M. Provide grounding and bonding; see Section 26 0526.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

**SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Division 08, Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 11. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.

12. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
13. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
14. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
15. Wall Plates: Comply with Section 26 2726.
16. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com/#sle.
 - c. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co; _____: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
- D. Underground Boxes/Enclosures:
 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As required by the NEC to accommodate quantity and sizes of conduits connected to box..
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 4. Provide logo on cover to indicate type of service.
 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.
 - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:

- 1) Hubbell Incorporated; Quazite Products; _____:
www.hubbellpowersystems.com/#sle.
 - 2) MacLean Highline; _____: www.macleanhigline.com/#sle.
 - 3) Oldcastle Precast, Inc; _____: www.oldcastleprecast.com/#sle.
- b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Division 08 as required where approved by the Architect.
 2. Unless dimensioned, box locations indicated are approximate.
 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 4. Locate boxes so that wall plates do not span different building finishes.
 5. Locate boxes so that wall plates do not cross masonry joints.
 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.

- c. Electrical rooms.
- d. Mechanical equipment rooms.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
- N. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches deep.
 - 2. Flush-mount enclosures located in concrete or paved areas.
 - 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 - 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section Division 07, Firestopping.
- Q. Close unused box openings.
- R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- S. Provide grounding and bonding in accordance with Section 26 0526.
- T. Identify boxes in accordance with Section 26 0553.

3.03 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 0533.16

**SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- C. Section 26 2726 - Wiring Devices: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components. Use color code indicated in labeling details on Drawings.
 - 2. Include equipment name/designation shown on Drawings for all equipment and the following additional information:
 - a. Panelboards:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
 - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - 6) Label each circuit breaker with manufacturer provided circuit number following NEMA standard numbering.
 - b. Transformers:
 - 1) Identify voltage and phase for primary and secondary.
 - 2) Identify power source and circuit number and disconnecting means when separate from primary overcurrent protective device. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - c. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 3. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - 4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 - 5. Use identification label at each fused switch to identify required NEMA fuse class and size.
 - 6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 - 7. Use floor marking tape or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction. Coordinate marking method and color with Owner.
 - 8. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
 - c. Motor control centers.
 - d. Elevator control panels.
 - e. Industrial machinery.

9. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
 - c. Service Equipment: Include the following information in accordance with NFPA 70.
 - 1) Nominal system voltage.
 - 2) Available fault current.
 - 3) Clearing time of service overcurrent protective device(s).
 - 4) Date label applied.
 10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection for feeders.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 4. Use underground warning tape to identify direct buried cables.
- D. Identification for Raceways:
1. Use voltage markers or identification labels to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
 2. Use factory-painted conduits to identify specified systems for accessible conduits.
 - a. Maximum Intervals: 20 feet.
 - b. Color Code:
 - 1) Refer to labeling details on Drawings.
 - 2) Fire Alarm System: Red.
 3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 4. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 5. Use underground warning tape to identify underground raceways.
 6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify specified systems.
 - a. Color-Coded Boxes: Field-painted in accordance with Division 09 Painting Sections per the same color code used for raceways.

- b. For exposed boxes in public areas, do not color code.
 - 3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
- F. Identification for Devices:
 - 1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
 - 2. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
 - 3. Use identification label to identify serving branch circuit for all wiring devices.
 - 4. Use identification label to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic nameplates suitable for exterior use.
 - 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/8 inch; engraved text.
 - 3. Attachment: Two-part epoxy, non-corrosive machine screws, or rivets.
 - a. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 - 1. Manufacturers:
 - a. Brady Corporation; _____: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
 - 1. Minimum Size: 1.5 inches by 4 inches.
 - 2. Legend:
 - a. Refer to labeling details on Drawings for additional requirements.
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
 - c. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 - 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Refer to labeling details on Drawings for additional requirements.
- D. Format for General Information and Operating Instructions:
 - 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

- A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. HellermannTyton; _____: www.hellermannntyton.com/#sle.
 3. Panduit Corp: www.panduit.com/#sle.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, or heat-shrink sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
1. Do not use handwritten text.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products; _____: www.seton.com/#sle.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
- F. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Manufacturers:
1. Brady Corporation; _____: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 3. Seton Identification Products; _____: www.seton.com/#sle.

- B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.06 FLOOR MARKING TAPE

- A. Manufacturers:
 - 1. Brady Corporation; _____: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Insite Solutions, LLC; _____: www.stop-painting.com/#sle.
 - 4. Seton Identification Products; _____: www.seton.com/#sle.
- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.07 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.brimar.com/#sle.
 - 2. Clarion Safety Systems, LLC; _____: www.clarionsafety.com/#sle.
 - 3. Insite Solutions, LLC; _____: www.stop-painting.com/#sle.
 - 4. Seton Identification Products; _____: www.seton.com/#sle.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
 - 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum or rigid plastic signs.
 - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 - 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
 - 1. Materials: Use factory pre-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Enclosure front.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.

4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using rivets, epoxy cement, or stainless steel machine screws and to interior surfaces using epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 6 to 8 below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION 26 0553

**SECTION 26 0583
WIRING CONNECTIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 0533.13 - Conduit for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 2726 - Wiring Devices.
- F. Section 26 2816.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 2816.16.
- C. Wiring Devices: As specified in Section 26 2726.
- D. Flexible Conduit: As specified in Section 26 0533.13.
- E. Wire and Cable: As specified in Section 26 0519.
- F. Boxes: As specified in Section 26 0533.16.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 26 0583

SECTION 26 2100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Division 31, Trenching: Excavating, bedding, and backfilling.

1.03 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.04 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
 - 2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 SUBMITTALS

- A. Drawings prepared by Utility Company.
- B. Project Record Documents: Record actual locations of equipment and installed service routing.

1.07 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).
 - 2. NFPA 70 (National Electrical Code).
 - 3. The requirements of the Utility Company.
 - 4. The requirements of the local authorities having jurisdiction.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility: As indicated on drawings.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Civil Drawings, NEC, and utility company requirements.

- E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements.
- F. Provide required protective bollards in accordance with Utility Company requirements.
- G. Provide required support and attachment components in accordance with Section 26 0529.
- H. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.04 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION 26 2100

**SECTION 26 2200
LOW-VOLTAGE TRANSFORMERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Small power centers (mini unit substations).

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2416 - Panelboards.

1.03 REFERENCE STANDARDS

- A. 10 CFR 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- G. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.
- H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

1. Small Power Centers: Include panelboard bus ampacity, integrated short circuit ampere rating, and circuit breaker sizes and ampere ratings.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
 1. Small Power Centers: Include panel arrangements.
 2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 1. Greater than 10 kVA: 104 degrees F maximum.
 2. Less than 10 kVA: 77 degrees F maximum.

1.09 WARRANTY

- A. See Division 01, Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.
- E. Source Limitations: Provide transformers produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide transformers suitable for application under seismic design criteria in accordance with Section 26 0548 where required. Include certification of compliance with submittals.

- C. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F.
 - b. Less than 10 kVA: Not exceeding 77 degrees F.
- D. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- E. Impregnate core and coil assembly with non-hydropscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- F. Basic Impulse Level: 10 kV.
- G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 SMALL POWER CENTERS (MINI UNIT SUBSTATIONS)

- A. Description: Factory assembled unit with integral primary circuit breaker, transformer, and distribution section with secondary main and branch circuit breakers; ratings and panel arrangements as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous windings.
- D. Winding Taps: Two 5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20.
- G. Mounting Provisions: Suitable for wall mounting.
- H. Unit Enclosure:
 - 1. Environment Type per NEMA EN 10250: Type 3R.
 - 2. Construction: Steel.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.
 - 5. Provide lockable hinged door for compartment housing circuit breakers.
- I. Secondary Distribution Panel:
 - 1. Comply with applicable requirements of Section 26 2416.
 - 2. Bus: Copper.
 - 3. Branch Circuit Breakers: Bolt-on.

2.04 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
 - 2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 - 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section Division 03, Cast-In-Place Concrete.
 - 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 - 5. Where transformers are indicated to be stacked on the drawings, use factory or field-fabricated metal stand to support upper transformer stacked above a floor-mounted transformer. Provide concrete pad of adequate size to mount both lower transformer and stand. Construct stand to allow future removal of lower transformer while providing all required clearances.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.
- K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
- L. Identify transformers in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2200

**SECTION 26 2416
PANELBOARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2025.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- G. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Division 01, Product Requirements for additional provisions.
 2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.

- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.
- E. Source Limitations: Provide panelboards and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from a single supplier.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide painted steel boxes for surface-mounted panelboards, finish to match fronts.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- L. Load centers are not acceptable.
- M. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
 2. Sub-feed lugs.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Aluminum or copper.
 3. Ground Bus Material: Aluminum or copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.

- b. Provide interchangeable trip units for circuit breaker frame sizes 400 amperes and larger.
- 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 6. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
- 7. Do not use tandem circuit breakers.
- 8. Do not use handle ties in lieu of multi-pole circuit breakers.
- 9. Provide circuit breaker handle-ties for multi-wire branch circuits as required by NFPA 70.
- 10. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - c. Handle Clamp (lock-on device): Set-screw type mechanism for locking circuit breaker handle in ON position.
 - d. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

2.05 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 0526.
- K. Install all field-installed branch devices, components, and accessories.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Set field-adjustable circuit breaker tripping function settings as indicated.

- N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- O. Provide filler plates to cover unused spaces in panelboards.
- P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 250 amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

**SECTION 26 2726
WIRING DEVICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches, including motor-starting switches.
- B. Receptacles.
- C. Wall plates and covers.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Notify Engineer/Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1. Wall Dimmers: Include derating information for ganged multiple devices.
- B. Project Record Documents: Record actual installed locations of wiring devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 WIRING DEVICES - GENERAL REQUIREMENTS

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Except where explicitly permitted, substitution of combination switch-and-receptacle devices for separate switches and receptacles is not permitted.
- C. Wiring Device Applications:
 1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with metallic weatherproof while-in-use covers.
- D. Wiring Device Finishes:
 1. Provide wiring device finishes as described below, unless otherwise indicated.
 2. Wiring Devices, Unless Otherwise Indicated: Gray with stainless steel wall plate.

2.02 WALL SWITCHES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Arrow Hart, a brand of Eaton.
- B. General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Motor-Starting Wall Switches: Horsepower-rated switches without overload protection, toggle operator..
 1. Rated for 1 hp at 120VAC, 2hp at 240V-277VAC, with stainless steel cover plate and lockout guard/bracket.

2.03 RECEPTACLES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Arrow Hart, a brand of Eaton.

- B. General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. GFCI Receptacles:
 - 1. General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 - 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.04 WALL PLATES AND COVERS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 - 2. Intermatic, Inc: www.intermatic.com/#sle.
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 4. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 5. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Weatherproof Receptacle Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.
 - 1. Nonmetallic covers are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer/Architect to obtain direction prior to proceeding with work.
 - 4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices, unless noted otherwise on the Drawings.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.04 FIELD QUALITY CONTROL

- A. See Division 01 Section on Quality Requirements for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer/Architect.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

SECTION 26 2813 FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fuses.

1.02 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Fuses: One set(s) of three for each type and size installed.
 - 2. Fuse Pullers: One set(s) compatible with each type and size installed.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. Littelfuse, Inc: www.littelfuse.com/#sle.
- C. Mersen: ep-us.mersen.com/#sle.

2.02 APPLICATIONS

- A. Individual Motor Branch Circuits: Class RK1, time-delay.

2.03 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.

- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- I. Provide the following accessories where required to complete installation:
 - 1. Fuseholders: Compatible with indicated fuses.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 26 2813

**SECTION 26 2816.16
ENCLOSED SWITCHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2813 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013 (Reaffirmed 2023).
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Engineer/Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of enclosed switches.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Division 01, Product Requirements for additional provisions.
2. See Section 26 2813 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01 ENCLOSED SAFETY SWITCHES

- A. Manufacturers:
 1. ABB: www.electrification.us.abb.com/#sle.
 2. Eaton Corporation: www.eaton.com/#sle.
 3. Schneider Electric: www.se.com/#sle.
 4. Siemens Industry, Inc: www.siemens.com/#sle.
 5. Source Limitations: Furnish products produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.
- B. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:
 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
 - b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

- I. Provide with switch blade contact position that is visible when the cover is open.
- J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- P. Heavy Duty Switches:
 - 1. Comply with NEMA BS 31047.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
- Q. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
 - 3. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install enclosed switches plumb.

- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Identify enclosed switches in accordance with Section 26 0553.

3.03 FIELD QUALITY CONTROL

- A. See Division 01, Quality Requirements for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2816.16

**SECTION 26 5100
INTERIOR LIGHTING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Luminaires, including those interior to the building and exterior at the Chiller Yard.
- B. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.

1.03 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019 (Reaffirmed 2025).
- B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2023.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Notify Engineer/Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 3. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting) and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Division 01, Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, drivers, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 BALLASTS AND DRIVERS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Install accessories furnished with each luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer/Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer/Architect. Secure locking fittings in place.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Engineer/Architect, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all fixtures/drivers that have failed..

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5100

**SECTION 28 4600
FIRE DETECTION AND ALARM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modification of existing fire alarm system and associated components, including control units, related equipment, initiating devices, and notification appliances.

1.02 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 26 0533.16 - Boxes for Electrical Systems.

1.03 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authorities having jurisdiction.
- B. BAS: Building automation system.
- C. DMNS: Distributed mass notification system.
- D. ECS: Emergency communications system.
- E. EoL: End-of-line.
- F. EVACS: Emergency voice/audio communication systems.
- G. FACU: Fire alarm control unit.
- H. HVAC: Heating, ventilation, and air conditioning.
- I. IDC: Initiating device circuit.
- J. LAN: Local area network.
- K. MNS: Mass notification system.
- L. NAC: Notification appliance circuit.
- M. NPLFA: Non-power-limited fire alarm.
- N. PLFA: Power-limited fire alarm.
- O. SLC: Signaling line circuit.
- P. SOO: Sequence of operation.

1.04 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 305 - Standard for Fire Alarm System Job Practices; 2018.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.
- H. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.
- I. UL 268A - Standard for Smoke Detectors for Duct Application; Current Edition, Including All Revisions.

- J. UL 464 - Standard for Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories; Current Edition, Including All Revisions.
- K. UL 521 - Standard for Heat Detectors for Fire Protective Signaling Systems; Current Edition, Including All Revisions.
- L. UL 864 - Control Units and Accessories for Fire Alarm Systems; Current Edition, Including All Revisions.
- M. UL 1971 - Standard for Signaling Devices for the Hearing Impaired; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of devices with potential conflicts or view obstructions.
 - 2. Coordinate submittals to confirm equipment and associated components are capable of indicated settings, and manufacturer documentation identifies required compatible product listings.
 - 3. Notify Engineer/Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meetings:
 - 1. Conduct meeting with facility representative to review device locations.
 - 2. Conduct meeting with facility representative and other related equipment manufacturers to discuss fire alarm system interface requirements.
 - 3. Conduct meeting to review anticipated installation of code-required smoke control requirements, product solutions, and SOO.
 - 4. Convene one week before starting work for review of documented SOO for system applications.
- C. Sequencing:
 - 1. Verify exact termination locations required for boxes, enclosures, and equipment.
 - 2. Do not begin installation of conductors and cables until installation of conduit and pathways between termination points is complete.
 - 3. Sequence work to protect cabling (e.g., overspray painting, physical stress, and insulation damage or covering markings).
 - 4. Verify naming convention for equipment identification, including room names and numbers, prior to creation of final drawings, reports, and labels.
- D. Scheduling:
 - 1. Arrange access to facility for data collection with facility representative.
 - 2. Where work involves interruption of existing electrical or fire alarm system service, arrange interruption with Owner.
 - a. Arrange test start and end with responsible reporting service. Confirm system normal operating mode and record as-found and as-left settings.
 - b. Arrange work to disable individual devices or circuits for minimal disruption if possible.
 - c. Arrange in accordance with NFPA 72 fire alarm system impairment requirements.
 - d. Where required by AHJ, arrange systems or partial system out of service interruption in accordance with requirements of building, life safety, and fire codes (e.g., approved fire watch plus required notifications, tags at each fire department connection and control valve, and AHJ notification when excess hours).

1.06 SUBMITTALS

- A. Evidence of designer qualifications.
- B. Comply with NFPA 72 chapter "Documentation," including noting names of installers, owners, and system classification information.

- C. Design Documents: Submit all information required for plan review and permitting by AHJ, including floor plans, riser diagrams, and description of operation.
 - 1. Copy (if any) of list of data required by AHJ.
 - 2. NFPA 72 "Record of Completion", filled out to extent known at time.
 - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A, and complete listing of software required.
 - 4. Manufacturer's detailed product data sheet for each component, including wiring diagrams, and circuit length limitations. Catalog pages and product descriptions include ratings, dimensions, finishes, service conditions, and included features.
 - 5. Certification by Contractor that system design complies with Contract Documents.
- D. Shop Drawings: Submit installation documentation required for plan review and permitting by AHJ, including floor plans showing locations of fire alarm system components, enlarged drawn to identified scale plan view, and riser diagrams.
 - 1. System zone boundaries and interfaces to fire safety systems.
 - 2. Show locations of components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 3. Include elevations and details of proposed equipment arrangements.
 - 4. Include system interconnection schematic riser diagram showing proposed and approved cable size and type; coordinated with floor plans and describing circuit class, survivability, and application specific information required by NFPA 72.
 - 5. Include typical wiring diagrams for devices, notification appliances, remote indicators, annunciators, remote test stations, and EoL and power supervisory devices.
 - 6. Include requirements and control diagrams for interfacing with other systems.
 - 7. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; standby and spare capacity calculations; notification appliance circuit loop resistance and voltage drop calculations, including spare capacity.
 - 8. List of devices and notification appliances on each SLC, with spare capacity indicated.
 - 9. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 - 10. Certification by either FACU manufacturer or manufacturer of related equipment.
 - 11. Certification by FACU manufacturer that system design complies with Contract Documents.
 - 12. Certification by Contractor that system design complies with Contract Documents.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Evidence of installer qualifications.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.
 - 3. Submit NFPA 72 "Inspection and Test," filled out.
- I. Operating and Maintenance Data: Revise and resubmit until acceptable; have one set available during closeout demonstration:
 - 1. Complete set of specified design documents, as approved by AHJ.
 - 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 - 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 - 4. List of recommended spare parts, tools, and instruments for testing.
 - 5. Replacement parts list with current prices, and source of supply.
 - 6. Detailed troubleshooting guide and large scale input/output matrix.

7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
- J. Project Record Documents: See Section 01 7800 for additional requirements, have one set available during closeout demonstration:
 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, and updated input/output chart.
- K. Closeout Documents:
 1. Certification by manufacturer that system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion," filled out completely and signed by installer and authorized representative of AHJ.

1.07 QUALITY ASSURANCE

- A. Copies of Design Criteria Documents: For duration of project, maintain at project site copy of each referenced document that prescribes execution requirements; bound together. Also, NFPA 72, relevant portions of other applicable codes, and instructions and guidelines of AHJ. Include in submittals upon completion.
- B. Designer Qualifications: NICET Level III (three) or Level IV (four) certified fire alarm technician or registered fire protection engineer, employed by FACU manufacturer, Contractor, or installer, with experience designing fire alarm systems in jurisdictional area of AHJ.
- C. Installer Qualifications: Firm with minimum three years documented experience installing fire alarm systems of specified type and providing contract maintenance service as regular part of their business.
 1. Authorized representative of FACU manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 2. Installer Personnel: At least two years of experience installing fire alarm systems.
 3. Supervisor: Level III (three) or Level IV (four) certified fire alarm technician; furnish name and address.
 4. Contract maintenance office located within 50 miles of project site.
 5. Certified in the State in which the Project is located as fire alarm installer.
- D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL), and acceptable to AHJ.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NECA 305.
- B. Handle carefully to avoid damage to internal components, enclosure, and finish.
- C. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.09 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
- B. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer/Architect and obtain direction before proceeding with work.

C. Existing Conditions:

1. Modifications to Existing System:

- a. Remove inactive or abandoned cables and components from existing fire alarm system.
- b. Remove unused existing components and materials from site and dispose according to local and federal requirements.
- c. Remove accessible portion of abandoned cables unless tagged with identification product suitable to withstand based on installed environment.

1.10 WARRANTY

A. Fire Alarm System Detectors: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

B. Fire Alarm System Notification Appliances: Provide minimum 1-year year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 FIRE ALARM SYSTEM

A. General Requirements:

1. Provide modifications and extensions to existing fire alarm system complying with NFPA 70, NFPA 72, and consisting of required equipment, conduit, cabinets, outlet boxes, wiring, connectors, hardware, supports, accessories, components, software, and system programming as necessary for complete operating system that provides functional intent indicated.
2. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. 36 CFR 1191 and ADA Standards.
 - b. Requirements of State Fire Marshal.
 - c. Requirements of AHJ.
 - d. Applicable local codes.
 - e. Contract Documents.
 - f. NFPA 72; "should" is mandatory; where conflicts between requirements require deviation, identify deviations clearly on design documents.
3. Fire Alarm System Products:
 - a. Listed, classified, and labeled as suitable for purpose intended.
 - b. Installation Environments: Provide products suitable for their respective indoor applications.
4. Fire Alarm System Design Information:
 - a. Building Code: Comply with applicable building code.
 - 1) Principle Occupancy: As indicated on Architect code summary drawings.
 - 2) Principle Use: As indicated on Architect code summary drawings.
 - 3) Occupant Evacuation Method: Total building.
 - 4) Equipment Room Rating: None required.
 - 5) Fire Suppression System: Fully sprinkled.
 - (a) Types:
 - b. NFPA 72 Fire Alarm System Classification: Remote supervising station.
 - c. Smoke and Heat Detector Coverage: Partial or selective coverage in accordance with NFPA 72.
 - d. Signal Priorities:
 - 1) See fire alarm system matrix indicated on drawings.
5. Provide fire alarm circuits in accordance with NFPA 70.
 - a. Wiring and Wiring Methods:
 - 1) General Requirements:
 - (a) Comply with requirements for wiring and wiring methods in accordance with NFPA 70.

- (b) Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum-rated, listed and labeled as suitable for use in return air plenums.
 - 2) Fire Alarm Circuits:
 - (a) Comply with NFPA 70 for conditions and types required for multiconductor cable systems.
 - (b) Power-Limited Fire Alarm (PLFA) Circuits:
 - (1) Provide identification for PLFA circuits in accordance with NFPA 70.
 - 6. Provide pathway class designations and pathway survivability, as defined in NFPA 72.
 - a. Provide monitoring of conductors and other signaling channels for integrity and circuit performance.
 - b. Pathway Class Designations:
 - 1) Unless otherwise indicated or required, pathways to meet the following requirements (field verify and match existing):
 - (a) SLCs: Class B (star, tee-tap, multi-tap, with no return).
 - (b) IDCs: Class B (daisy-chain with EoL resistor device installed at end of circuit).
 - (c) Other Wiring:
 - (1) Other life safety control features not covered above (e.g., air handling system interfaces), wired as Class D (failsafe, intended operation is performed in event of pathway failure).
 - (2) Where Class D wiring is not possible due to limitation of equipment, wiring limited to 3-feet between addressable control module and equipment and be installed in metallic conduit.
 - c. Pathway Survivability:
 - 1) Unless otherwise indicated or required, pathways to meet requirements for Pathway Survivability Level 1 (nonrated cable installed in metal raceway, building protected by automatic sprinkler system).
- B. Fire Alarm System Interfaces and Control Functions:
 - 1. UL 864 listed unless otherwise indicated.
 - 2. Descriptions below are intended to provide means for interface. See project SOOs, narrative, and input/output matrix for execution requirements.
 - 3. Provide initiating devices, interfaces, and control functions for emergency control function interfaces in accordance with NFPA 72.
 - 4. Provide monitoring of interconnected systems. Coordinate notification appliance alternate markings as indicated on drawings.
 - 5. HVAC Systems:
 - a. Air Handling Units (AHUs):
 - 1) Provide duct smoke detectors for units indicated on drawings.
 - 2) Provide remote test station for each duct smoke detector unless explicitly indicated as not required.
 - 3) Provide output signal to shut down units with at least one duct smoke detector via addressable relay module.
 - 4) Where fire/smoke dampers are located downstream of unit, provide monitoring point input to determine that unit is not operational and subsequently provide output signal to close such dampers via addressable relay module and power isolation relay.
 - b. Remote Test Stations: Provide remote test station for each duct smoke detector unless explicitly indicated as not required. Unless otherwise indicated, use remote test stations only in clean, dry, indoor, nonhazardous locations.
 - 1) Locate in ceiling below duct detector location.
 - 2) In areas with no ceiling, locate on wall at location and height indicated on Drawings.
 - 6. Smoke Dampers and Fire/Smoke Dampers:

- a. Provide output signal to close fire/smoke damper via addressable relay module and power isolation relay.
- b. Fire/smoke damper activated as indicated on drawings.

2.02 FIRE ALARM CONTROL UNITS AND RELATED EQUIPMENT

- A. Existing Notifier NFS-320 Fire Alarm System.

2.03 FIRE ALARM SYSTEM INITIATING DEVICES

- A. Manufacturers:
 1. Source Limitations: Furnish initiating devices produced by same manufacturer as FACUs and matching existing devices (Notifier).
- B. General Requirements:
 1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable FACU; suitable for connection to FACU SLCs.
 2. Provide devices and associated accessories suitable for intended application and location to be installed. Unless otherwise indicated, use addressable devices and addressable interface modules only in clean, dry, indoor, nonhazardous locations.
 3. Surface-Mounted Devices: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
- C. Spot-Type Detectors:
 1. Utilize plug-in mounting to separate base with tamper-resistant feature; provide bases as indicated or as required.
 2. Addressable Detectors:
 - a. Provide LED indication of normal operation and regular communication with FACU and alarm condition.
 - b. Provide reporting of analog sensor values to FACU.
 3. Smoke Detectors:
 - a. Listed and labeled as complying with UL 268.
 - b. Provide sensor type (e.g., photoelectric, ionization) as indicated.
 - c. Provide automatic drift compensation.
 4. Thermal/Heat Detectors:
 - a. Listed and labeled as complying with UL 521.
 - b. Provide sensor type (e.g., fixed temperature, rate-of-rise) and rating as indicated.
- D. Duct Smoke Detectors:
 1. Listed and labeled as complying with UL 268A.
 2. Ratings: Compatible with air velocity, temperature, and humidity requirements for installed duct.
 3. Housing: Select as required for application.
 4. Sampling Tubes: Select as required for installation in duct to be monitored.
- E. Accessories:
 1. Remote Test Stations: Allows for detector key switch test and reset; provides visual and audible indication of alarm condition.

2.04 FIRE ALARM SYSTEM NOTIFICATION APPLIANCES

- A. Manufacturers:
 1. Source Limitations: Furnish notification appliances produced by same manufacturer as existing FACUs (Notifier).
- B. General Requirements:
 1. Provide signaling notification appliances listed for fire-protective service and intended operating mode, public or private; suitable for connection to FACU notification appliance circuits.

2. Provide notification appliances and associated accessories suitable for intended application and location to be installed. Use notification appliances only according to listed mounting (e.g. ceiling, wall).
 3. Surface-Mounted Notification Appliances: Provide manufacturer's accessory surface mount backboxes or suitable outlet/device box.
 4. Notification Appliance Derating: Include device derating adjustments in accordance with listing where applicable, including the following.
 - a. Where accessory protective guards or enclosures are utilized.
 - b. Where required by field conditions (e.g., ambient temperature and sound).
 5. Notification Appliance Color: Match existing.
- C. Visible Notification Appliances:
1. Public Mode Operation: Listed and labeled as complying with UL 1971.
 2. Strobes: Clear or nominal white lens with flash rate of 1 Hz unless otherwise indicated or required; xenon or LED light source with maximum pulse duration of 0.02 seconds; candela rating as indicated.
 - a. Provide field-selectable 15/30/75/110 candela devices.
 - b. Where field-selectable candela strobes are specified, substitution of fixed candela strobes is not permitted.
- D. Audible Notification Appliances:
1. Listed and labeled as complying with UL 464.
 2. Rated Sound Pressure Level: As required to achieve design sound pressure levels, but not less than 75 dBA at 10 feet for public mode operation or 45 dBA at 10 feet for private mode operation in accordance with UL 464.
 3. Horns: Selectable tone, including at minimum NFPA 72 temporal 3 pattern and continuous; minimum of two selectable volume levels.

2.05 WIRE AND CABLE

- A. General Requirements:
1. Comply with NFPA 70 listing and marking requirements for cables.
 2. Substitution of fire alarm listed cables for communication wiring, in accordance with NFPA 70, is not permitted.
 3. Provide cables as indicated or as required for connections between system components.
- B. Power-Limited Fire Alarm Cables (PLFA):
1. Comply with applications of listed cables in accordance with Chapter 7 of NFPA 70.
 - a. Fire alarm cable substitutions in accordance with NFPA 70: Permitted.
- C. Non-Power-Limited Fire Alarm Cables (NPLFA):
1. Comply with NPLFA circuit conductor properties in accordance with NFPA 72.
 2. Comply with listing requirements in Chapter 7 of NFPA 70.

2.06 ACCESSORIES

- A. Provide components as indicated or as required for connection of fire alarm system to devices and other systems indicated.
- B. Provide EoL resistors as required for wiring supervision.
- C. Protective Covers for Fire Alarm Devices:
1. Listed to same standard as device being protected.
 2. Provide guards to protect devices where subject to mechanical damage; listed for use with detector.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements.
- B. Verify that system capacities listed in manufacturer instructions align with designed system.

- C. Verify that mounting surfaces are ready to accept components and equipment, with suitable support frames and anchors installed where required.
- D. Verify ratings, configurations, and characteristics of system components.
- E. Verify rough-ins for field connections.
- F. Verify that work likely to damage fire alarm system has been completed.
- G. Perform preinstallation tests and inspections per manufacturer's instructions and in accordance with NECA 305.
- H. Verify that system bonding is in accordance with Section 26 0526.

3.02 PREPARATION

- A. Prior to installation, confirm environment of installation area is clean, and with ambient temperature, humidity, and ventilation requirements are per manufacturer's written instructions.
 - 1. Clean pathways thoroughly to remove foreign materials before installing conductors and cables.
 - 2. Clean dirt, debris, plaster, and other foreign materials from equipment enclosures, cabinets, and outlet boxes.
 - 3. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Follow tool requirements for installation, including torquing adjustments, as listed in manufacturer documentation.
- C. Remove detector dust covers prior to system energization.

3.03 INSTALLATION

- A. Install field-devices, components, and accessories in accordance with the following:
 - 1. Manufacturer's instructions, applicable codes, and Contract Documents.
 - 2. NECA 1.
 - 3. NECA 305.
 - 4. NFPA 72.
 - 5. NFPA 70; including requirements for mechanical execution of work.
- B. Field Locations:
 - 1. Obtain Owner's approval of locations of devices before installation.
 - 2. Arrange equipment to provide minimum operational clearances and required maintenance access in accordance with manufacturer's instructions and NFPA 70.
 - 3. Conceal wiring, conduit, outlet boxes, and supports where installed in finished areas; maintain code-required access.
- C. Raceways and Supports:
 - 1. Coordinate locations of outlet boxes as required for installation. Only install boxes and equipment at locations based on application standards indicated in NFPA 72.
 - a. See Section 26 0533.16.
 - 2. Secure and support raceways at intervals complying with NFPA 70. Provide supports where vertical rise exceeds permissible limits.
 - a. See Section 26 0529.
 - 3. Install firestopping to preserve fire resistance rating of partitions and other elements.
- D. Wiring and Connections:
 - 1. Maintain separation of Class 1, Class 2, Class 3 remote-control, signaling, fire alarm circuits, and power-limited circuits in accordance with cable insulation class and NFPA 70.
 - 2. Maintain circuit pathway and class designations in accordance with NFPA 72 for configuration, separation, and survivability.
 - 3. Comply with permitted and not permitted installations for wires, cables, cable routing assemblies, communications circuits, and fire alarm circuits in accordance with NFPA 70.
 - 4. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by AHJ. Provide independent support from building

- structure and suspended ceiling systems. Do not provide support from raceways, piping, ductwork, or other systems.
- 5. Provide grounding and bonding in accordance with Section 26 0526.
- 6. Comply with manufacturer's minimum cable sizes or ratings.
- 7. Do not exceed manufacturer's recommended maximum power, signal, or network cable lengths between components.
- 8. Neatly train and bundle conductors inside boxes, wireways, and cabinets.
- E. Fire Alarm System Components:
 - 1. Install field-installed devices, components, relays, accessories, and when applicable EoL resistors.
 - a. Install wiring to supervisory devices and associated EoL resistors as required for supervision of hardwired connections
- F. System Identification:
 - 1. Identify devices, notification appliances, components, cables, and equipment in accordance with approved submittals. See Section 26 0553.
 - 2. Confirm fire alarm system programming meets requirements of SOO and sub-system SOOs.
 - 3. Post laminated final SOO and system drawings at FACU.
 - 4. Mark location of disconnecting means for NPFLA circuits.
- G. Troubleshooting and Installer Checks:
 - 1. Field test connectivity periodically during installation process to avoid unexpected troubleshooting.
 - 2. Check system operation for notification, FACU functions, circuit supervision, alarm initiating devices, supervisory initiating devices, dress panels/doors/covers, and programming before performing field tests.
- H. Fire Alarm System Tests:
 - 1. Perform required tests of NFPA 72. Record measured values during operational checks.
 - 2. Confirm functional testing of fire alarm system is as indicated in Contract Documents.

3.04 FIELD QUALITY CONTROL

- A. Provide services of manufacturer's authorized representation to perform installation and assist in inspection, testing, and adjusting. Include manufacturer's detailed testing procedures and field reports and with submittals.
- B. Provide equipment, two-way radios for testing personnel use, tools, and supplies required to accomplish inspection and testing.
- C. Notify Owner and Engineer/Architect at least two weeks prior to scheduled inspections and tests.
- D. Inspect and test in accordance with manufacturer's instructions.
- E. Inspect wiring and components for damage and defects.
- F. Perform additional requirements related to testing and inspection during system startup.
- G. Test for interface with other systems.
- H. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.
- I. Diagnostic Period: After successful completion of inspections and tests, operate system to normal mode for at least 14 days without system or equipment malfunctions.

3.05 SYSTEM STARTUP

- A. Obtain Owner approval prior to performing system startup.
- B. Manufacturer Services: Provide services of manufacturer's authorized representation to systems startup. Include manufacturer's detailed startup procedures with submittals.

- C. Prepare and start equipment and systems in accordance with manufacturer's instructions and recommendations.

3.06 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust initiating device settings to achieve desired operation as indicated in submittals.
- C. Reprint and reinstall damaged or misinstalled labels; maintain neat and square to installed location good workmanship - see NECA 1; maintain consistent placements for identification on products of similar type.
- D. Adjust devices to be flush and level.
- E. Program system parameters according to requirements of Owner.

3.07 CLEANING

- A. Check tightness of electrical connections. Replace damaged components and provide closure plates for vacant positions. Provide circuit directory updates for related power branch circuits.
- B. Clean and repair existing materials and equipment that remain or are indicated for reuse.
- C. Clean dirt, debris, plaster, and other foreign materials from outlet boxes and fire alarm system equipment and components.
- D. Clean fire alarm system equipment and components according to manufacturer's instructions and NECA 305.
- E. Clean surfaces and interiors of boxes and device cover plates in accordance with manufacturer's instructions to remove dirt, fingerprints, debris, plaster, and other foreign materials.
- F. Repair scratched or marred exposed surfaces to match original factory finish.

3.08 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify AHJ and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide services of installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that work is complete and correct; perform preliminary tests as required.
- E. Provide tools, software, and supplies required to accomplish inspection, testing, and document results.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of AHJ; document each inspection and test.
- G. Correct defective work, adjust for operation, and retest until entire system complies with Contract Documents.
- H. Diagnostic Period: After successful completion of inspections and tests, operate system in normal mode for at least 14 days without system or equipment malfunctions.
 - 1. Record system operations and malfunctions.
 - 2. If malfunction occurs, start diagnostic period over after correction of malfunction.
 - 3. Owner will provide attendant operator personnel during diagnostic period; schedule training to allow Owner personnel to perform normal duties.
 - 4. At end of successful diagnostic period, fill out and submit NFPA 72 "Inspection and Testing Form."

3.09 CLOSEOUT ACTIVITIES

- A. Closeout Demonstration: Demonstrate operation of all functions to Owner.

1. Be prepared to conduct any of required tests.
 2. Have minimum one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of FACU manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by AHJ; notify AHJ with enough time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Substantial Completion of project cannot be achieved until inspection and testing is successful and the following:
1. Specified diagnostic period without malfunction has been completed.
 2. Approved operating and maintenance data has been delivered.
 3. All aspects of operation have been demonstrated to Owner.
 4. Final acceptance of fire alarm system has been given by AHJ.

3.10 PROTECTION

- A. Protect installed fire alarm system from subsequent construction operations.

END OF SECTION 28 4600