
PROJECT MANUAL

DIVISIONS 00 - 28

YORK COUNTY MAIN PUBLIC LIBRARY ELECTRICAL UPGRADES

138 EAST BLACK STREET, ROCK HILL, SC 29730

**DEVITA & ASSOCIATES, INC.
PROJECT NO.: 23501-03**

DOCUMENT DATE: JUNE 6, 2025
ISSUED FOR BID

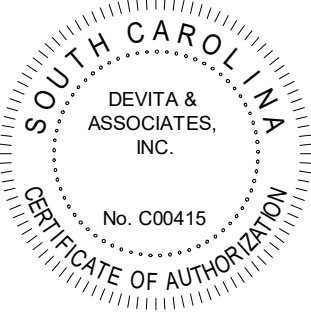
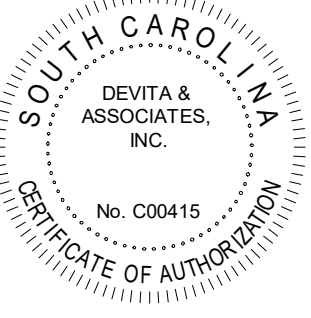
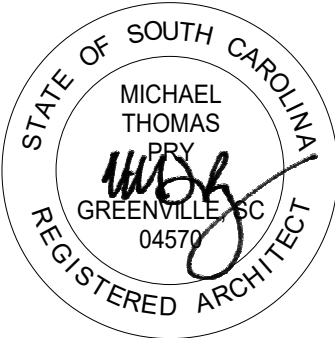
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SECTION 00 2113 – INSTRUCTIONS TO BIDDERS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- 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. York County Government's form "Invitation for Bid", is hereby incorporated into the Procurement and Contracting Requirements by reference. This document contains the Invitation for Bids and Instructions to Bidders.

PART 2 - PRODUCTS (Not Applicable)**PART 3 - EXECUTION (Not Applicable)**

END OF SECTION 00 2113

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SECTION 00 7200 - GENERAL CONDITIONS

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.

16.1.3 Refer to Section 00 6116 "Contractor's General Warranty" for warranty form.

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.

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. SUBSURFACE CONDITIONS FOUND DIFFERENT

44.1. Should the CONTRACTOR encounter subsurface and/or latent 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

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SECTION 01 1000 - SUMMARY**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes:
1. Project information.
 2. Work covered by Contract Documents.
 3. Work under separate contracts.
 4. Access to site.
 5. Coordination with occupants.
 6. Work restrictions.
 7. Specification and drawing conventions.
- B. Related Sections:
1. Division 01 Section "Temporary Facilities" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: York County Main Public Library Electrical Upgrades.
- B. Project Location: 138 E. Black Street, Rock Hill, SC 29730.
- C. Owner: York County Government, PO Box 180, 6 South Congress Street, York, SC 29745
1. Contact Person: Mr. Scott Burns, Facilities Maintenance and Capital Projects Manager.
 2. Telephone Number: 803-818-5743.
- D. Engineer: DeVita & Associates, Inc., 33 Villa Road, Suite 300, Greenville, SC 29615.
1. Contact Person: Mr. Shannon Epps, P.E., Project Manager.
 2. Telephone Number: 864-232-6642.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
1. Full renovation of power distribution equipment, lighting fixtures & controls, fire alarm system, paging system, and data cabling. Removal of all abandoned items above ceiling. Full ceiling replacement, replacement and tie-in of HVAC diffusers, and ductwork cleaning.
- B. Type of Contract: Project will be constructed under a single prime contract.

1.5 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period.
 - 1. Minimize access and use of adjacent roadways and streets to only that as required for construction, utility service disconnect, transfers and connections; coordinate access and use with the Owner.
- B. Condition of Adjacent Properties: Maintain portions of adjacent properties affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Owner does not intend to continue to occupy adjacent portions of the existing facility during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.8 MAINTENANCE OF EXISTING OPERATIONS

- A. The Owner is now occupying and conducting his business in the existing area but will not continue to do so during the progress of the work covered by this Contract. The Contractor shall provide ample protection for the Owner's equipment and apparatus against the elements and possible harm or injury from any operations of the Contractor during the entire period of construction.
- B. The existing building interior shall be positively protected from dust and dirt at all times during the construction phases. Noise shall be kept to absolute minimum. All construction operations shall be separated from the existing areas as applicable by barriers as described in Section 01 50 00.

1.9 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Provide access to and from site as required by law and by Owner.
- C. 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.
- D. Utility Outages and Shutdown:
 - 1. Limit shutdown of utility services to two hours at a time, arranged at least 72 hours in advance with Owner.
 - a. Longer durations are acceptable with Owner approval.
 - b. Prevent accidental disruption of utility services to other facilities.

1.10 WORK SEQUENCE

- A. It is recognized that this project will tend to disrupt operations of the existing facility; however, certain vital operations and services now in the construction area cannot be terminated or disrupted. Therefore, relocation of these operations and services must be accomplished in a certain planned sequence so as to allow continuous operation of these services. Phasing of this Project will be as directed by the Owner, or as generally indicated on the Contract Documents.

1.11 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with requirements and limitations for visitation and access to York County properties, buildings & grounds and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Work hours are generally from approximately 7:00 AM to 5:00 PM.
 - 1. 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.
 - 2. 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.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than five (5) days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to adjacent property owners and Owner occupancy with Owner.
 - 1. Notify Owner not less than two (2) days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking: Smoking is not permitted within the project site.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
 - 3. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- B. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
 - 1. General Notes.
 - 2. Annotations.
 - 3. Key Notes.
 - 4. Material Symbols.

- 5. Graphic Symbols.
- C. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 1. Abbreviations: Materials and products are identified by abbreviations on the Drawings.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 1000

SECTION 01 2100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
- C. Related Requirements:
 - 1. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 00 2113 "Instructions to Bidders" for bid form requirements for listing allowances.

1.3 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, for work that will be completed under the base construction contract, but for which the exact costs or scope are indeterminate at the time of bid. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect/Engineer under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Above Ceiling Demolition Work: Include an allowance of twenty-thousand dollars (\$20,000) to remove from above existing ceilings unknown abandoned cabling and other items not indicated on the drawings, as directed by Owner or Architect/Engineer. Work to be performed while the existing ceilings are removed. Allowance shall include materials and labor. Work shall be performed in accordance with Section 02 4100 "Demolition".

END OF SECTION 01 2100

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections:
1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions" or similar form.
1. Where Contractor considers Engineer's action on ASIs warrants change to the Contract Time or the Contract Sum, Contractor shall submit a Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. Contractor shall notify Engineer in writing within 3 days of receipt of ASI response that a Change Proposal will be submitted.
 - b. Contractor shall submit Change Proposal within 7 days of receipt of ASI, and shall not proceed with change(s) until a Change Order has been approved.
 - c. If Contractor proceeds with change(s) prior to a Change Order being approved, change(s) shall be done at Contractor's own risk and Contractor shall assume change(s) are being done with no change in Contract Time or no change in Contract Sum ("zero cost").

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 2. Within time specified in Proposal Request or 14 days when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Division 01 Section "Substitutions" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE ORDER PROCEDURES

- A. Upon Contractor's submittal of Change Order Proposal to Engineer, Engineer will review and execute Owner's "Change Order Specimen" to the Contractor for signature. Upon Contractor's signature, Contractor shall forward "Change Order Specimen" to Owner for Owner's approval and signature. Owner will forward approved Change Orders to Engineer for distribution.
1. Where Change Order documents are not provided by the Owner, or are insufficient, Engineer will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: With prior approval by Owner, the Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 2600

SECTION 01 2700 - PROJECT MANAGEMENT AND COORDINATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. General project coordination procedures.
 2. Administrative and supervisory personnel.
 3. Coordination drawings.
 4. Requests for Information (RFIs).
- B. Related Sections:
1. Division 01 Section "Construction Schedules" for preparing and submitting Contractor's construction schedule.
 2. Division 01 Section "Project Meetings" for administrative procedures for project meetings.
 3. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 4. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Engineer, or Contractor seeking information from each other during construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
 2. Number and title of related Specification Section(s) covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 7 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 COORDINATION

- A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Startup and adjustment of systems.
 8. Project closeout activities.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings in accordance with requirements in individual Sections, where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Review: Engineer will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are the Contractor's responsibility. If the Engineer determines that the coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, the Engineer will so inform the Contractor, who shall make changes as directed and resubmit.
- C. Coordination Drawing Prints: Prepare coordination drawing prints in accordance with requirements of Division 01 Section "Submittals."

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
- 1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
- 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Engineer.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or similar form.

- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 3:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Engineer's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within three days of receipt of the RFI response.
 - 1) Contractor shall submit a Change Proposal for RFIs resulting in a change to the Contract Time or the Contract Sum, and shall not proceed with change(s) until a Change Order has been approved.
 - 2) If Contractor proceeds with change(s) prior to a Change Order being approved, change(s) shall be done at Contractor's own risk. Contractor shall assume change(s) are being done with no change in Contract Time or no change in Contract Sum ("zero cost").
- E. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within three days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Project number.
 3. Name and address of Contractor.
 4. Name and address of Owner and Engineer.
 5. RFI number including RFIs that were dropped and not submitted.
 6. RFI description.
 7. Date the RFI was submitted.
 8. Date Engineer's response was received.
 9. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 10. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 2700

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 2. Division 01 Section "Construction Schedules" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 3. Division 01 Section "Submittals" for administrative requirements governing the preparation and submittal of the submittal schedule.

1.3 SCHEDULE OF VALUES

- A. Coordination: Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
1. Application for Payment forms with continuation sheets.
 2. Submittal schedule.
 3. Submit the schedule of values to Engineer at earliest possible date but no later than ten days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Owner.
 - c. Owner's project number.
 - d. Name of Engineer.
 - e. Contractor's name and address.
 - f. Date of submittal.
 2. Submit draft of AIA Document G703 Continuation Sheets.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts where appropriate.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

6. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The periods for progress payments are indicated in the Agreement between Owner and Contractor. The periods of construction work covered by each Application for Payment are indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment, unless alternate forms are provided by the Owner.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds.
 15. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After the issuing of the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 5. AIA Document G707, "Consent of Surety to Final Payment."
 6. Owner's "Non-Influence Affidavit".
 7. Owner's "Statutory Affidavit".
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Material Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
- K. Engineer shall complete and furnish a "Monthly Billing Report" that will be attached to each reviewed and approved Application for Payment.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 2900

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SECTION 01 3000 - SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section 01 3100 "Construction Schedules" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section 01 4000 "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
- D. See Division 01 Section 01 7800 "Closeout Procedures" for submitting warranties.
- E. See Division 01 Section 01 7810 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- F. See Division 01 Section 01 7820 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- G. See Division 01 Section 01 7900 "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Engineer's responsive action.
- B. Informational Submittals: Written information that does not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section 01 3100 "Construction Schedules" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough time for submittal review, including time for re-submittals, as follows. Time for review shall commence on the Engineer's receipt of the submittal. No

extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.

1. Initial Review: Allow 14 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. The Engineer will advise the Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Re-submittal Review: Allow 14 calendar days for review of each re-submittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record the Contractor's review and approval markings and action taken by the Engineer.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of the Engineer.
 - d. Name and address of the Contractor.
 - e. Name and address of the subcontractor.
 - f. Name and address of the supplier.
 - g. Name of the manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06 1000.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06 1000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. The Engineer will return submittals, without review, received from sources other than Contractor.
- H. Re-submittals: Make re-submittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with the approval notation from the Engineer's action stamp.

- a. Third and subsequent reviews of submittals marked “Rejected” or “Revise and Resubmit” by the Engineer, and in the case of previously reviewed shop drawings, evaluation of substitutions proposed by the Owner or Contractor and revisions to the Contract Documents (if necessary) resulting therefrom, shall be considered “Additional Services” and shall be billed at the Engineer’s prevailing hourly rate to the party proposing the substitution. This also includes reviewing alternate submittals for unavailable, long-lead time, or discontinued items.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating the approval notation from the Engineer's action stamp.

1.4 CONTRACTOR'S USE OF ENGINEER'S CAD FILES

- A. General: At Contractor's written request, copies of Engineer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 1. See Division 01 Section 01 3900 "Electronic Deliverable Release" for requirements to use engineering CAD files, and associated fees for preparing files for Contractor’s use.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.
 4. Number of Copies: Submit all electronically as PDF digital files.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Engineer's CAD Drawings is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.

- c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shop-work manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on 30" x 42" sheets.
 3. Number of Copies: Submit one PDF digital file.
 - a. Engineer will provide submittal review comments on "Submittal Comments" sheet(s) attached to front of shop drawing submittals unless large format submittals require comments to be made on individual shop drawing sheets.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 4 full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. The Engineer will return 2 samples of the submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit 4 sets of Samples. Engineer will retain 2 Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.

- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
 - 1. Number of Copies: Submit one PDF digital file.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section 01 3100 "Construction Schedules."
- G. Application for Payment: Comply with requirements specified in Division 01 Section 01 2900 "Payment Procedures."
- H. Cost Loaded Schedule: Comply with requirements specified in Division 01 Section 01 2900 "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.
 - 1. Number of Copies: Submit one PDF digital file.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit one PDF digital file of each submittal, unless otherwise indicated.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section 01 4000 "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section 01 2700 "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section 01 3100 "Construction Schedules."
- D. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- G. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- J. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- K. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- L. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- M. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- N. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section 01 7820 "Operation and Maintenance Data."
- O. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
- R. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

- S. Construction Photographs: Comply with requirements specified in Division 01 Section 01 3220 "Photographic Documentation."
- T. Material Safety Data Sheets (MSDSs): Submit information directly to the Owner; do not submit to the Engineer.
 - 1. The Engineer will not review submittals that include MSDSs and will return them for re-submittal.

2.3 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Engineer.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit 4 copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and provide comments/details for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to the Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of the Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

- A. General: Engineer will not review submittals that do not bear evidence of thorough Contractor review and the Contractor's approval stamp and will return them without action.
 - 1. Submittals not reviewed and coordinated with other Work of the Contract will be returned by the Engineer without action for re-submittal.
- B. Action Submittals: The Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. The Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.
- C. Informational Submittals: The Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. The Engineer will forward each submittal to appropriate party.

- D. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 3000

SECTION 01 3100 - CONSTRUCTION SCHEDULES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION: This section covers provisions for construction schedules.

1.2 RELATED REQUIREMENTS:

- A. See Division 01 Section 01 2900 "Payment Procedure" for Schedule of Values.
- B. See Division 01 Section 01 3120 "Project Meetings" for schedules of project meetings.
- C. See Division 01 Section 01 3000 "Submittals" for scheduling submittals.

1.3 GENERAL:

- A. CPM (Critical Path Method) Schedules: Contractor's working schedules used to plan, organize, and execute work; record and report actual performance, progress and cost; and demonstrates how Contractor plans to complete remaining work.
 - 1. Prepare using current edition of Microsoft Project or equal.
- B. Contractor's Responsibility: Nothing in these requirements shall be deemed to be usurpation of Contractor's authority and responsibility to plan and schedule work as he sees fit, subject to all other requirements of Contract Documents.

1.4 SCHEDULES:

- A. Prepare in CPM form a Preliminary Schedule and an As-Planned Schedule.
- B. Preliminary Schedule: At time of Preconstruction Conference, submit preliminary schedule to Owner's project representative for Owner's review and comment.
 - 1. Reflect intended detailed sequence and duration of work activities for period commencing with Notice to Proceed and continuing through first ninety (90) calendar days.
 - 2. Schedule in sufficient detail to clearly portray work activities, including procurement and submittals sequence of activities, along with phasing, and milestones associated with this period. Sitework activities to be clearly distinguished from the building's activities.
 - 3. Schedule shall be consistent with As-Planned Schedule specified below.
 - 4. Schedule will be reviewed by Owner for acceptability of form and format only.
 - 5. Progress Payments: Submittal and acceptance of Preliminary Schedule is a prerequisite for Contractor's first progress payment.
- C. As-Planned Schedule: No later than thirty (30) calendar days after Notice to Proceed submit As-Planned CPM schedule to Owner's project representative for Owner's review and comment. Schedule will be reviewed by Owner for acceptability of form and format only. Submit one (1) digital copy for Owner's use.
 - 1. Schedule shall reflect intended detail of work activities for entire period of contract performance commencing with Notice to Proceed of work on-site and continuing through Contract Completion.
 - 2. Schedule in sufficient detail to clearly portray all work activities and entire cycle of submittal, approval, fabrication and delivery as related to significant items of

design, material, and permanent equipment fixtures. Schedule to indicate separately sitework activities from building activities. With respect to the building, schedule should group interior activities distinctly from exterior shell and structural activities that are required to be completed prior to building being weathertight.

3. Schedule shall be a fully detailed CPM Schedule and submitted in form of time network diagram(s) (plotted with early start dates).
4. The Schedule shall reflect the number of normal bad weather days as stated for each month in the General Conditions.
5. The Schedule shall reflect the project cost breakdown as submitted in the applications for payment including Change Orders as separate line items.
6. Progress Payments:
 - a. Initial acceptance of As-Planned Schedule and submittal of Schedule Updates shall be prerequisite for progress payments commencing with second progress payment after Notice to Proceed and continuing to Contract Completion.
 - b. The Contractor shall show on the complete CPM Schedule the work-in-place cost for each activity. The cumulative amount for all activities shall equal the total contract price. Overhead and profit shall be pro-rated on all activities for the entire project length.

1.5 UPDATING AND REPORTING:

- A. Schedule Updates: Update Schedule monthly based on actual progress. Reflect actual start and/or finish dates of activities along with percentage of completion for activities started and not yet complete.
- B. Monthly Status Reports: Submit Monthly Status Report to Owner's project representative and Owner. Summarize work performed during preceding month, indicate milestones achieved and update Schedule of Values. Include separate listing of activities which are causing delay to work progress. Include narrative to define problem areas, anticipate delays and impact on schedule. Report corrective action taken, or proposed, and its effect, including effect of changes on schedules of separate contractors. Include items which the Contractor perceives as being Owner or Engineer delays to the timely completion of the project.
- C. Progress Meetings: Discuss progress of project in conjunction with CPM Schedule at progress meetings. Include:
 1. Actual completion dates for work items completed since last meeting.
 2. Actual start dates for work items started since last meeting.
 3. Estimating remaining durations for work items in progress.
 4. Estimated start dates for work items scheduled to start before next meeting.
 5. Changes in durations of work items.
 6. Identification of current and most critical paths to required completion dates.
 7. Discussion on narrative report (See B. above).
 8. Submission of weekly "Look Ahead" report and statement indicating what achievements are anticipated prior to the next meeting.
 9. Discussion on procurement schedules, material and equipment fabrication and/or shipping updates.
- D. Work Progress:
 1. Should any activity fail to be completed with-in fifteen (15) days after indicated schedule date, Contractor shall expedite completion of activity by whatever means Owner deems appropriate and necessary without additional compensation to Contractor.

2. Should any activity be thirty (30) or more days behind schedule, Owner shall have the right to perform activity or have activity performed by whatever method Owner may deem appropriate. Costs incurred by Owner in this activity shall be deducted from Contract Price.
3. It is expressly understood and agreed that failure by Owner to exercise option to expedite activity shall not be construed as precedent for any other activities or as waiver of Owner's rights to exercise his rights on subsequent occasions.
4. Contract Extensions: Float time is not time for exclusive benefit of either Owner or Contractor.
 - a. Extensions of time for contract performance as specified in contract will be granted only to the extent that equitable time adjustments to affected work items exceed total float time along affected paths of accepted computer printout report in effect at that time and are in accordance with General and Supplementary Conditions.
 - b. Slippage of work items will not be basis for time extension to contract unless and until such slipped work items are resolved in accordance with General and Supplementary Conditions.

1.6 SUBMITTALS:

- A. Submit updated schedules monthly concurrent with pay application, accurately depicting progress to first day of each month.
- B. Submit digitally in PDF format for Engineer's review.
- C. Distribute reviewed schedules to:
 1. The Owner.
 2. The job site file.
 3. The sub-contractors.
 4. The Engineer.
- D. Documentation: At completion of project, submit as-built computer printout report and time-scaled network diagram reflecting project as-built critical paths. Provide one (1) digital PDF copy.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 3100

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SECTION 01 3120 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for project meetings.

1.3 MEETING REQUIREMENTS

- A. Owner/Architect (Engineer)/Contractor (OAC) Project meetings:
 - 1. Contractor will conduct meetings throughout Project life for discussion project status and resolution of Project issues. These meetings will be held on a frequency related to project status, i.e., bi-weekly or monthly as required by status of Work.
 - 2. Attendance by the Contractor, Owner's Representative, and Engineer or Engineer's Representative is mandatory. Engineer's consultants, Contractor's subcontractors, suppliers, and others are to attend on an as-needed basis.
 - 3. Suggested agenda:
 - a. Progress review.
 - b. Schedule.
 - c. Look ahead.
 - d. Submittal's status.
 - e. RFI status.
 - f. Change Order status.
 - g. Open Items.
 - h. Other business.
- B. Contractor's Progress Meetings: Requirements below are intended for Contractor, subcontractors, sub-subcontractors, and material suppliers for discussion and resolution of Project specific situations. Attendance by Owner, Owner's Representative, or Engineer's consultants is not mandatory.
 - 1. Meetings between Contractor, Owner, Engineer, or any combination of the three for purpose of discussing Project progress or resolving problems are delineated above.
 - 2. Owner and Engineer may attend meetings to ascertain work is expedited consistent with Contract Documents and construction schedules.
- C. Contractor requirements include:
 - 1. Schedule and administer preconstruction meeting, periodic progress meetings, and specially called meetings throughout work progress.
 - 2. Prepare agenda for meetings.
 - 3. Distribute written notice of each meeting seven days in advance of meeting date.
 - 4. Make physical arrangements for meetings.
 - 5. Preside at meetings.
 - 6. Record minutes; include significant proceedings and decisions.
 - 7. Reproduce and distribute copies of minutes within three days after each meeting as follows:
 - a. One copy to each participant in meeting.

- b. One copy to parties affected by decisions made at meeting.
 - c. One copy of minutes to Engineer.
 - d. One copy to Owner's Representative.
- D. Representatives of contractors, subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- E. Related sections:
 - 1. Section 01 3000: Submittals.
 - 2. Section 01 3100: Construction Schedules.
- F. Pre-construction meeting:
 - 1. Schedule within 10 days after date of Notice of Award.
 - 2. Location: Central site, convenient for all parties, designated by the Owner.
 - 3. Attendance:
 - a. Owner's Representative.
 - b. Engineer and professional consultants.
 - c. Contractor's Superintendent.
 - d. Major subcontractors.
 - e. Major suppliers.
 - f. Others, as appropriate.
 - 4. Suggested agenda:
 - a. Distribution and discussion of:
 - 1) List of major subcontractors and suppliers.
 - 2) Projected Construction Schedules.
 - b. Critical work sequencing.
 - c. Major equipment deliveries and priorities.
 - d. Project coordination: Designation of responsible personnel.
 - e. Procedures and processing of:
 - 1) Field decisions.
 - 2) Proposal requests.
 - 3) Submittals.
 - 4) Change Orders.
 - 5) Applications for Payments.
 - f. Adequacy of distribution of Contract Documents.
 - g. Procedures for maintaining Record Documents.
 - h. Use of premises:
 - 1) Office, work and storage areas.
 - 2) Owner's requirements and logistics.
 - 3) Utility shut-down and disconnection coordination.
 - i. Temporary facilities, controls, and construction aids.
 - j. Temporary utilities.
 - k. Safety and first-aid procedures.
 - l. Security procedures.
 - m. Housekeeping procedures.
 - n. Other: _____
- G. Contractor's Progress meetings:
 - 1. Schedule regular periodic meetings as required, but not less than two meetings monthly.
 - 2. Hold called meetings as required by progress of work.
 - 3. Meeting's locations: Project field office of Contractor.
 - 4. Attendance:
 - a. Subcontractors, as appropriate to agenda.
 - b. Suppliers, as appropriate.

- c. Engineer and professional consultants, as needed or required.
- d. Others.
- 5. Suggested agenda:
 - a. Review, approval of minutes of previous meeting.
 - b. Review of work in progress since previous meeting.
 - c. Field observations, problems, conflicts.
 - d. Utility shut-down and disconnection coordination.
 - e. Problems which impede Progress Schedule.
 - f. Review of off-site fabrication, delivery schedules.
 - g. Corrective measures and procedures to regain projected schedule.
 - h. Revisions to Progress Schedule.
 - i. Progress; schedule, during succeeding work period.
 - j. Coordination of schedules.
 - k. Review submittal schedules; expedite as required.
 - l. Maintenance of quality standards.
 - m. Pending changes and substitutions.
 - n. Review proposed changes for effect on:
 - 1) Progress schedule and on completion date.
 - 2) Other contracts of Project.
 - o. Review Monthly Pay Applications.
 - p. Other.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 3120

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SECTION 01 3900 – ELECTRONIC DELIVERABLES RELEASE**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. The electronic media (EM), and therefore any and all electronic deliverable, described herein is considered as original design of a building or site and is subject to the copyright protection as an "architectural work" under Section 102 of the Copyright Act, 17 U.S.C., amended on October 27, 2000.
- B. This Section includes the policy and requirements to be followed to allow the Contractor to purchase EM from DeVita & Associates, Inc. (DEVITA). Included are specifications, CAD electronic files of drawings, and the general provisions for transmittal of document in machine readable form. Since most e-mail carriers are limited to 5 to 6 MB files, the transfer of large drawing and specification files will be limited to USB Flash Drives or FTP site. Since the preparation of EM require time and expense and since the information included thereon is copyrighted material representing professional services, the Contractor shall be charged for this reproduction service.
- C. Drawing files shall be in AutoCAD 2024 format, or Revit Architecture/MEP 2023. Additional formats may be provided at an additional cost.
- D. This section consists of a "Release" that is to be copied in full, signed by the Contractor, Sub-contractor, or Vendor, and returned to DEVITA with the applicable payment for the EM.

1.3 RELEASE AGREEMENT FORM

- A. Use facsimile of form provided at the end of this Section.

PART 2 - PRODUCTS (NOT APPLICABLE)
PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 3900

**Electronic Files Release
Agreement**

Date: _____

Project #: _____

Client: _____

Project Name: _____

Recipient Name: _____

Recipient Email: _____

Due Date: _____

Fee: _____

Data/Document(s) Requested:

DeVita & Associates, Inc. (hereinafter referred to as "DEVITA") and the RECIPIENT agree to the following terms related to the release and use of certain Electronic Files/Documents:

- I. DEVITA will provide to the RECIPIENT certain drawings, specifications, or other documents prepared by DEVITA or its sub consultants in electronic format and/or on electronic media. These documents are hereinafter collectively referred to as "ELECTRONIC Files". The ELECTRONIC Files are instruments of DEVITA's services performed solely for the Owner/Client's benefit and to be used solely for this Project. DEVITA does not represent that the information contained in the ELECTRONIC Files are suitable for use on any other project or for any other purpose. If the ELECTRONIC Files are used for any other project or purpose without DEVITA's specific written permission, the risk of such use shall be assumed solely by RECIPIENT or other user. Prior to any reuse of the ELECTRONIC files for another purpose, DEVITA and the RECIPIENT shall agree on the amount and method of payment of additional compensation to which DEVITA shall be entitled.
- II. The ELECTRONIC Files are provided merely as a convenience to the RECIPIENT. The ELECTRONIC Files do not replace or supplement the paper copies of any drawings, specifications, or other documents included in the Contract Drawings for use on the project.
- III. DEVITA makes no representation, warranty or guarantee that ELECTRONIC Files: (1) are suitable for any other usage or purpose, or (2) have any particular durability, or (3) will not damage or impair the Recipient's computer or software, or (4) contain no errors or mechanical flaws or other discrepancies that may render them unsuitable

for the purpose intended by the RECIPIENT.

- IV. Due to the unsecured nature of the ELECTRONIC Files and the inability of DEVITA or the RECIPIENT to establish controls over their use, DEVITA assumes no responsibility for any consequences arising out of the use of the data. It is the sole responsibility of the RECIPIENT to check the validity of all information contained herein. The RECIPIENT shall at all times refer to the signed and sealed drawings of the project during all phases of the project. The RECIPIENT shall assume all risks and liabilities resulting from the use of this data, and the RECIPIENT agree(s) to waive any and all claims and liability against DEVITA and its subconsultants resulting in any way from the use of the ELECTRONIC Files.
- V. RECIPIENT also agree(s) to defend, indemnify, and save harmless DEVITA, its subconsultants, officers, agents, employees, and shareholders from and against any and all claims, damage, liability, costs, judgment, suit, or expense (including reasonable defense and attorney fees) arising in any manner from the use, reuse, or modification of the ELECTRONIC Files.

Please execute this Agreement in the space provided below to indicate your acceptance of the terms and conditions of the release itemized in this Agreement. Upon receipt of the executed Agreement and payment of any fees, we will transfer the ELECTRONIC Files to the address or email provided.

READ AND ACCEPTED BY

DEVITA & ASSOCIATES, INC.
P. O. Box 1596
Greenville, SC 29602

Enter Client Name
Enter Street Address
Enter City, State Zip

DEVITA Signature

Client Signature

Print Name & Title

Print Name & Title

Date:

Date:

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SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Division 01 Section "Construction Schedules" for developing a schedule of required tests and inspections.
 - 2. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.

4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.
 2. Demonstrate the proposed range of aesthetic effects and workmanship.
 3. All components of mockups shall be tested by a third-party independent qualified testing agency to verify components meet individual requirements specified.
 4. Obtain Engineer's and third-party testing agency's written approval of mockups before starting work, fabrication, or construction.
 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Owner, Engineer, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.

6. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
 2. Protect construction exposed by or for quality-control service activities.
 3. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

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SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The)
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
ACI	ACI International (American Concrete Institute)
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
ARI	Air-Conditioning & Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International
AWS	American Welding Society
CISCA	Ceilings & Interior Systems Construction Association

CSI	Construction Specifications Institute (The)
CTI	Cooling Technology Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
ESD	ESD Association
FM Approvals	FM Approvals
FSA	Fluid Sealing Association
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IES	Illuminating Engineering Society
IEST	Institute of Environmental Sciences and Technology
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITU	International Telecommunication Union
MFMA	Metal Framing Manufacturers Association, Inc.
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NADCA	National Air Duct Cleaners Association

NAIMA	North American Insulation Manufacturers Association
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
SAE	SAE International
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers
SIA	Security Industry Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
STI	Steel Tank Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association

USGBC U.S. Green Building Council

- B. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE Army Corps of Engineers

CPSC Consumer Product Safety Commission

DOC Department of Commerce

DOD Department of Defense

DOE Department of Energy

EPA Environmental Protection Agency

FAA Federal Aviation Administration

FCC Federal Communications Commission

FDA Food and Drug Administration

GSA General Services Administration

HUD Department of Housing and Urban Development

NIST National Institute of Standards and Technology

OSHA Occupational Safety & Health Administration

PHS Office of Public Health and Science

SD State Department

TRB Transportation Research Board

USDA Department of Agriculture

USPS Postal Service

- C. Codes, Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

ADAAG Americans with Disabilities Act (ADA) Accessibility Guidelines

CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
FS	Federal Specification
MILSPEC	Military Specification and Standards
IBC	International Building Code

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. See Division 01 Section 01 7300 "Execution" for progress cleaning requirements.
- C. See Divisions 02 through 33 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by the Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, the Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 9-gauge, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-D top and bottom rails. Provide concrete bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, the Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use by construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 1. Provide temporary generator or other means to keep York County Library IT servers operational when normal power is not available. Coordinate requirements with Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service as necessary to complete the construction phase services.
 1. At each telephone, post a list of important telephone numbers including police and fire departments, the Contractor's home office, the Engineer's office, the Owner's Representatives office, the Owner's office, and the Prime subcontractors' field and home offices.
 2. Provide the superintendent with a cellular telephone for use during the duration of the Construction Phase. Provide the cell phone number to the Engineer, the Owner's Representative, and the Owner.
- J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail and high-speed Internet service in the field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within limits of construction area. Comply with NFPA 241.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- E. Project Identification and Temporary Signs: Provide Project identification and other signs as necessary. Install signs where indicated to inform public and individuals seeking entrance to Project. Obtain approval from the Engineer for all signage prior to installing any signs. Unauthorized signs are not permitted.
1. Provide temporary, directional signs for construction personnel and visitors.
 2. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.
- G. Temporary Elevator Use: Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work (at no cost to the Owner) so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- H. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas (at no cost to the Owner) so no evidence remains of correction work.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

- B. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- E. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by the Owner from fumes and noise.
 - 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 - 2. Construct dustproof partitions with 2 layers of 3-milpolyethylene sheet on each side. Cover floor with 2 layers of 3-milpolyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 - 3. Insulate partitions to provide noise protection to occupied areas.
 - 4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 - 5. Protect air-handling equipment.
 - 6. Weather strip openings.
 - 7. Provide walk-off mats at each entrance through temporary partition.
- F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking within the limits of construction.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section 01 7800 "Closeout Procedures".

END OF SECTION 01 5000

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections:
1. Division 01 Section "Substitutions" for requests for substitutions.
 2. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product" or similar language, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittals."
 - b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittals." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Where products are accompanied by the term "as selected," Engineer will make selection.
 2. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 3. Approved Equal: For products specified by name and accompanied by the term "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered, unless otherwise indicated.
 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with

requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Engineer's sample", provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitutions" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the specified product is no longer manufactured and available for purchase.
 2. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 3. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 4. Evidence that proposed product provides specified warranty.
 5. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 6. Samples, if requested.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 6000

SECTION 01 6300 – SUBSTITUTIONS

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED: Substitutions for products specified shall be allowed only under the conditions stated in this section.

1.2 SUBSTITUTIONS/PRIOR APPROVALS:

- A. If it is desired to use products different from those indicated in the Contract Documents, the party requesting the substitution shall make written application as described herein. The burden of proving equality of proposed substitutions rests on the party making the request for substitution.
1. Requests for substitution (written inquiries) shall reach the Engineer no later than the date and time specified in the Invitation for Bids. Requests received after this date will not be considered.

1.3 SUBMITTALS:

- A. Substitution Requests: Submit documentation of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
- B. Substitution Request Form: Use facsimile of form provided at the end of this Section.
- C. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
1. Date of request.
 2. Name of party proposing substitution.
 3. Project name.
 4. Specification reference.
 5. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature, identify:
 - (1) Product description.
 - (2) Reference standards.
 - (3) Performance and test data.
 - (4) Manufacturer's recommendations for use and installation.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 6. Itemized comparison of the proposed substitution with product specified, list all variations.
 7. Data relating to changes in construction schedule.
 8. Any effect of substitution on separate contracts.
 9. List of changes required in other work or products.
 10. Designation of required license fees or royalties.

11. Designation of availability of maintenance services, sources of replacement materials.
- B. If a proposed substitution is approved by the Engineer, an addendum will be issued to prospective bidders not less than five (5) days prior to the date set for opening bids. If a substitution does not appear in an addendum it shall mean that the Engineer has not approved the product and the successful bidder shall be responsible for furnishing materials and products in accordance with the Contract Documents.
- C. Following the receipt of bids, NO FURTHER REQUESTS for substitution of products or materials will be considered for the duration of the Work.

1.4 CONTRACTOR'S REPRESENTATION:

In connection with the use of any substitute item approved by the Engineer it shall be the Contractor's responsibility to see that such items meet all space requirements, and that any alterations to connecting items necessitated by use of the alternate items are properly made at no increase in cost to the Owner, and that all items are in compliance with the specification requirements. Contractor shall waive all claims for additional costs caused by substitutions which may subsequently become apparent.

PART 2 - PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 6300

SUBSTITUTION REQUEST

SPECIFIED ITEM:

Section Line Number Paragraph Description:

The undersigned requests consideration of the following:

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.

Attached data also includes a description of changes to the Contract Documents which the proposed substitution will require for its proper installation.

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

- The proposed substitution does not affect dimensions shown on drawings.
- The undersigned will pay for changes to the building design, including engineering design, detailing, and construction cost caused by the request substitution.
- The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
- Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

Submitted by: _____

Signature/Title: _____

Address: _____

Date: _____

Telephone: _____

Cost Credits: _____

Attachments: _____

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

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SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections:
 - 1. Division 01 Section "Cutting and Patching" for cutting and patching of selected portions of the Work.
 - 2. Division 02 Section "Demolition" for demolition and removal of selected portions of the Work.

1.3 QUALITY ASSURANCE

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

1.4 CODES AND WARRANTIES

- A. Existing Codes and Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to violate Codes and void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location of electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Engineer according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
- B. Building Lines and Levels: Locate and lay out control lines and levels for building components, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels.
- C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and

items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Utilize containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Material Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300

SECTION 01 7390 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
 - 1. Divisions 02 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operation Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety. Operating elements include the following:
 - 1. Primary operational systems and equipment.
 - 2. Control systems.
 - 3. Communication and Data Systems.
 - 4. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
 - 1. Equipment supports.

- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

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

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 – EXECUTION

3.1 ACCEPTABLE INSTALLER

- A. Applicators and Installers shall have three years' experience installing materials and systems being altered, shall be approved by the existing manufacturers, and have successfully completed three projects using similar systems being altered.

1.2 EXAMINATION

- A. Examine material and surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place materials, finishes or primers, and surfaces.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.3 PREPARATION

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

- B. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- C. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

3.4 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore materials and surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or power tools, or equipment designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces; Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspections: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Materials and Finishes: Restore exposed materials and finishes of patched areas and extend restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove soils, paint, mortar, oils, putty, and similar materials.
- E. Existing systems that are damaged as a result of the above work must be repaired and returned to their original operational condition. Owner must be notified to inspect and approve the work prior to it being covered up.

END OF SECTION 01 7390

SECTION 01 7800 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Closeout procedures.
- B. Substantial Completion.
- C. Final Review.
- D. Final cleaning.
- E. Adjusting.
- F. Warranties.
- G. Spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES:

- A. At the completion of the Project, and when Work is ready for Final Inspection, two reviews will be performed by the Engineer to establish acceptance of the Work. The terminology of these reviews shall be:
 - 1. Preliminary Review: The preliminary review will establish a checklist of items remaining to be corrected and completed for the Work to be considered "Substantially Complete".
 - 2. Final Review: The final review will determine whether items on the checklist have been corrected and completed, and whether the Project (or part thereof) can be accepted by the Owner. Final Review will establish the date of "Substantial Completion".

1.3 SUBSTANTIAL COMPLETION:

- A. The Date Of Substantial Completion of the Work (or designated portion thereof) is the Date certified by the Engineer when construction is sufficiently complete, in accordance with the Contract Documents, and when a Certificate Of Occupancy has been issued and submitted in accordance with requirements of the Contract Documents, so that the Owner can occupy or utilize the Work (or designated portion thereof) for the use for which it is intended.
- B. The Contractor shall notify the Engineer (in writing) that the Project (or designated portion) is "substantially complete"; and shall (at the same time) submit a list of items to be completed or corrected for final completion.
- C. The Engineer will make the "Preliminary Review" within seven days after notification by the Contractor that the Project is ready. The list of items remaining to be corrected prior to Final Review will be modified or expanded by the Engineer at the Preliminary Review.

- D. Should the Engineer consider the Work substantially completed, he will prepare and issue a Certificate of Substantial Completion (AIA G704), complete with signatures of the Owner and the Contractor, accompanied by the list of items remaining to be completed or corrected.

1.4 FINAL REVIEW:

- A. The Contractor shall notify the Engineer (in writing) that the Project is finally complete and ready for Final Review, and that:
 - 1. The Project has been inspected for compliance with and completed in accordance with the requirements of the Contract Documents.
 - 2. Equipment and systems have been tested in the presence of Owner's Representative and are operational.
 - 3. The list of items (remaining to be corrected or completed) has been completed, and that all items are ready for Final Review.
- B. The Engineer will make the Final Review, together with the Owner's representative, within seven days after notification.
 - 1. Should the Engineer consider that the Work is finally complete in accordance with requirements of the Contract Documents, he will request the Contractor to make Project Closeout Submittals.
 - 2. Should the Engineer consider that the Work is not finally complete, he will notify the Contractor (in writing) stating the reasons.
 - a. The Contractor shall take immediate steps to remedy the stated deficiencies and shall send a second written notice to the Engineer certifying that the Work is complete, at which time the Engineer will again review the Work.
 - b. Re-inspection costs shall be paid by the Contractor.

1.5 FINAL CLEANING:

- A. Execute final cleaning prior to final inspection.
- B. Clean interior and exterior glass, and surfaces exposed to view. Remove temporary labels, stains, and foreign substances. Polish transparent and glossy surfaces.
- C. Clean equipment and fixtures to a sanitary condition.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs and drainage systems.
- F. Clean Project Site. Sweep paved areas. Rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the Project Site.

1.6 ADJUSTING:

- A. Adjust operating Products and Equipment to ensure smooth and unhindered operation.

1.7 WARRANTIES:

- A. Provide duplicate, notarized copies.
- B. Execute and assemble documents from Subcontractors, suppliers, and Manufacturers.
- C. Provide Table of Contents and assemble in three D-size ring-binder, with durable plastic cover. Provide also in PDF digital format.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of Warranty Period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS:

- A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual Specification Sections.
- B. Deliver to Project Site, and place in location as directed. Obtain receipt prior to final payment.

1.9 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS:

- A. The following submittals shall be duly executed before delivery to the Designer.
 - 1. Contractor's Affidavit of Payment of Debts And Claims (AIA G706).
 - 2. Contractor's Affidavit of Release of Liens (AIA G706A).
 - 3. Consent of Surety to Final Payment (AIA G707).
 - 4. Separate releases of waivers of liens for Subcontractors, suppliers, and others with lien-rights against property of the Owner, together with a list of those parties.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 01 7800

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SECTION 01 7810 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Sections:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 GENERAL REQUIREMENTS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal: Submit one paper copy set and PDF electronic files of marked-up "as-built" record prints. Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal: Submit one paper copy set and PDF electronic files of marked-up "as-built" record prints. Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy and annotated PDF electronic files of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Locations and depths of underground utilities.
 - d. Revisions to routing of piping and conduits.
 - e. Revisions to electrical circuitry.
 - f. Actual equipment locations.
 - g. Duct size and routing.
 - h. Locations of concealed internal utilities.
 - i. Changes made by Change Order or Construction Change Directive.
 - j. Changes made following Engineer's written orders.
 - k. Details not on the original Contract Drawings.
 - l. Field records for variable and concealed conditions.
 - m. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Owner and Engineer.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: One paper copy and one annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Owner and Engineer.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file and one paper copy.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as one paper copy and scanned PDF electronic files of marked up paper copy of Product Data.
 1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as one paper copies and scanned PDF electronic files of marked up miscellaneous record submittals.
 1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Owner and Engineer reference during normal working hours.

END OF SECTION 01 7810

SECTION 01 7820 - OPERATION AND MAINTENANCE DATA

GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Emergency manuals.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of products, materials, and finishes; and mechanical, electrical, and plumbing systems and equipment.
- B. See Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

- A. Manual: Submit PDF electronic files of each manual in final form at least 14 calendar days before final inspection. The Engineer will return comments within 14 calendar days after final inspection.
 - 1. Correct or modify each returned manual to comply with the Engineer's comments. Submit PDF electronic file of each corrected manual within 14 calendar days of receipt of the Engineer's comments.

PRODUCTS

1.3 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of the Project.
 - 3. Name and address of the Owner.
 - 4. Date of submittal.
 - 5. Name, address, and telephone number of the Contractor.
 - 6. Name and address of the Engineer.
 - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
 - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on

spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

- a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
5. The Contractor will also provide the manuals in electronic format in PDF files. The PDF files must be organized in similar fashion described above, and submitted on USB flash drive.

1.4 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure, chemical release or spill, etc.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of the Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

1.5 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.

6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

1.6 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in the manual identified by product name and arranged to match the manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in the manual identified by product name and arranged to match the manual's table of contents. For

each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

- C. **Manufacturers' Maintenance Documentation:** Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. **Maintenance Procedures:** Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, and demonstration and training DVD that detail essential maintenance procedures:
- E. **Maintenance and Service Schedules:** Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. **Spare Parts List and Source Information:** Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. **Maintenance Service Contracts:** If applicable, include copies of maintenance agreements with name and telephone number of service agent.
- H. **Warranties and Bonds:** Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

EXECUTION

1.8 MANUAL PREPARATION

- A. **Emergency Manual:** Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. **Product Maintenance Manual:** Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. **Operation and Maintenance Manuals:** Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. **Manufacturers' Data:** Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. **Drawings:** Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7820

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SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections:
 - 1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and training content.
- C. Coordinate content of training with content of approved emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training: Provide on-site training and instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.

- c. Maintenance manuals.
- d. Identification systems.
- e. Warranties and bonds.
- f. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training material. Assemble training material into a training manual organized in coordination with requirements in Division 01 Section "Operation and Maintenance Data."

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Cleanup: Collect used and leftover training materials and give to Owner. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01 7900

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SECTION 02 41 00

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. ABC: Asphalt, Brick and Concrete
- B. ANSI: American National Standards Institute

- C. Architect: Architect shall be the Architect of Record for the project. For this project DP3 Architects, Ltd. will serve as the Architect.
- D. Coated ABC: Coated brick, concrete and concrete masonry units. Coatings shall include, but not be limited to: paint, stucco applications, plaster, etc.
- E. Contractor: Refers to the General Contractor and/or Subcontractor responsible for the Work under contract.
- F. Demolition: Total or selective destruction of building or portions of buildings; removal of building materials for renovation projects
- G. 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.
- H. Engineer: Authorized representative of the Owner. Engineer shall be the Engineer of Record for the project. For this project, DeVita & Associates, Inc. will serve as the Engineer.
- I. DOT: Department of Transportation
- J. IMPLOSION: Use of explosives for structure demolition.
- K. NFPA: National Fire Protection Association.
- L. OSHA: Occupational Safety and Health Administration
- M. 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.
- N. 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.
- O. SCDHEC: South Carolina Department of Health and Environmental Control
- P. 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 in accordance with all federal, state, and local laws, codes, and ordinances 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

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SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Slabs-on-grade.
 - 2. Equipment pads.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with fly ash; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture, indicating quantity of each ingredient and admixtures proposed or required. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength calculations.
 - 2. For mix designs based on trial, include proportions, test results, and graphic analysis indicating average compressive strength.
 - 3. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Schedule for Concrete Placement: Order-of-construction schedule by location in structure.
 - 1. Include shop drawings indicating all construction joints required, including any anticipated joints due to placement schedule.
- E. Submit description of planned procedures and protective measures for cold weather or hot weather concreting.
- F. Welding certificates.
- G. Qualification Data: For Installer.
- H. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

- I. Material Certificates: For each of the following, signed by manufacturers; indicate compatibility with application of surface applied flooring products where applicable:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Vapor retarders.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- J. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- K. Field quality-control test and inspection reports.
 - 1. Include copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on-Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
 - 1. Comply with requirements of the Concrete Manufacturers Association "Concrete Plant Standards."
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 305, "Hot Weather Concreting".
 - 4. ACI 306, "Cold Weather Concreting".
 - 5. ACI 308, "Guide to Curing Concrete".
 - 6. ACI 302, "Guide for Concrete Floor and Slab Construction".
 - 7. Concrete Repair Manual, by ACI and ICRI.
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

- I. The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes. The Contractor shall correct deficient concrete as directed by the Engineer.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store steel reinforcement off ground, under suitable cover or enclosed.
 - 2. Maintain ease of access for inspection and identification of materials.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Supporting devices for slabs-on-grade shall have sand plates.
- C. Tie Wire: 16 gauge annealed type.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Aggregates, General: Tested and passed within 6 months of use for the following:
 - 1. Gradation: ASTM C 136.
 - 2. Material Passing No. 200 Sieve: ASTM C 117.

3. Organic Impurities: ASTM C 40.
 4. Soundness: ASTM C 88.
 5. Clay Lumps: ASTM C 142.
 6. Lightweight Constituents: ASTM C 123.
 7. Abrasiveness of Coarse Materials: ASTM C 131.
 8. Soft Particles: ASTM C 235.
 9. Freeze/Thaw Resistance: ASTM C 66, ASTM C 682.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S 3M South coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size:
 - a. Percentage passing No. 200 sieve shall be less than 0.7%.
 - b. Nominal size 1 1/2": ASTM Size No. 467.
 - c. Nominal size 1": ASTM Size No. 57.
 - d. Nominal size 1/2": ASTM Size No. 7.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - a. Percentage passing No. 200 sieve shall be less than 3%.
- D. Water: ASTM C 94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride. Admixtures which result in more than 0.1% of soluble chloride ions by weight of cement are prohibited.
1. Water-Reducing Admixture: ASTM C 494, Type A.
 2. Retarding Admixture: ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.6 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
1. Products:
 - a. Fortifiber Corporation; Moistop Plus.
 - b. Raven Industries Inc.; Dura Skrim 8.
 - c. Reef Industries, Inc.; Griffolyn Type 85.
 - d. Stego Industries, LLC; Stego Wrap, 15 mils.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve,

10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.7 FLOOR AND SLAB TREATMENTS

- A. Penetrating Liquid Floor Treatment: ASTM C309 and C1315.
1. Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components.
 2. Odorless; colorless.
 3. Formulated to penetrate, harden, and densify concrete surfaces.
 4. Formulated to reduce water vapor and alkali migration detrimental to adhesion of applied sheet or tile floor finishes.
 5. Products:
 - a. Burke by Edoco; Titan Hard.
 - b. ChemMasters; Chemisil Plus.
 - c. ChemTec International; ChemTec One.
 - d. Concrete Waterproofing Products, Inc.; Creteseal CS2000.
 - e. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
 - f. Euclid Chemical Company (The); Euco Diamond Hard.
 - g. Meadows, W. R., Inc.; Liqui-Hard.
 - h. Symons Corporation, a Dayton Superior Company; Buff Hard.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products:
 - a. Burke by Edoco; BurkeFilm.
 - b. ChemMasters; Spray-Film.
 - c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
 - d. Euclid Chemical Company (The); Eucobar.
 - e. L&M Construction Chemicals, Inc.; E-Con.
 - f. MBT Protection and Repair, Div. of ChemRex; Confilm.
 - g. Meadows, W. R., Inc.; Sealtight Evapre.
 - h. Sika Corporation, Inc.; SikaFilm.
 - i. Symons Corporation, a Dayton Superior Company; Finishing Aid.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Characteristics: Acrylic polymer blend; non-yellowing from ultraviolet exposure; dustproofs concrete.
 2. Products:
 - a. ChemMasters; Safe-Cure Clear.

- b. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; High Seal.
- c. Euclid Chemical Company (The); Diamond Clear VOX.
- d. L&M Construction Chemicals, Inc.; Dress & Seal WB.
- e. MBT Protection and Repair, Div. of ChemRex; MasterKure-N-Seal VOC.
- f. Meadows, W. R., Inc.; Vocomp-20.
- g. Sonneborn, Div. of ChemRex; Kure-N-Seal.
- h. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- i. Tamms Industries, Inc.; Clearseal WB STD.

G. Evaporation Retarder:

Products:

- a. BASF Construction Chemicals; Master Builders, Confilm.

2.9 RELATED MATERIALS

- A. Expansion-Joint-Filler and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber for pavements and sidewalks, and ASTM D 1752, cork or self-expanding cork for slabs-on-grade.
- B. Preformed Control Joint Former for joints to receive sealant or for sawcut type joints. To be used only with approval of the Engineer.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Burlap: AASHTO M 182, Class 2 jute or kenaf cloth.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Proportion design mixes per the recommendations of ACI 211.1 for normal weight concrete and ACI 211.2 for structural lightweight concrete.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
 - 2. Design mixes to meet or exceed each requirement specified. Adjust mix design to meet the most stringent requirement.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 15 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use set-accelerating corrosion-inhibiting admixture in concrete mixtures where indicated.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Slabs-on-Grade (Interior): Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio by Weight: 0.45.
 - 3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 - 4. Maximum Nominal Aggregate Size: 1 inch.
 - 5. Maximum Slump Limit: 3-1/2 inches, plus or minus 1 inch.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
- B. Bend steel reinforcement in accordance with ACI 318.
 - 1. Do not heat steel reinforcement for bending. Bend or straighten bars cold.
 - 2. Do not bend partially embedded steel reinforcement, except as approved.

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, paragraphs 1 to 15 and 18 only, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete, unless specifically indicated otherwise on the drawings.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Installed penetrating conduits and embedded pipes in concrete shall comply with Section 6.3 of ACI 318.
 - a. No conduits or embedded pipes shall be located within supported slabs or slab-on-grade.

3.3 REMOVING AND REUSING FORMS

3.4 REUSING FORMS

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

3.5 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
 2. Allow six hours between completion of reinforcement installation and placement of concrete for special inspection.
- B. Clean reinforcement of dirt, grease, scale, loose rust, oil, paint and other foreign matter prior to installation.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Splicing and Embedment of Reinforcement: Conform to ACI 318 Chapter 12 for wired lap splices and embedment lengths.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- G. 1. "Hooking-up" or "Walking-in" of any reinforcement will not be permitted.

- H. Maintain required concrete cover dimensions indicated. Coordinate placement of conduit and inserts with reinforcement. Protect installed reinforcement from damage or displacement prior to and during concrete placement.

- I. 1. The Contractor shall repair or replace damaged, distorted, or displaced reinforcement.

3.7 JOINTS

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

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

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

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

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
3. Spacing of joints shall not exceed 2.5 times the thickness of the slab nor 15 feet on center. All panels should be square or nearly so. Joints shall typically isolate columns and run between columns.

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed and corrections made.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - a. Do not supplement mechanical consolidation by hand, spading, rodding, or tamping unless approved by Engineer.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Provide sufficient time for excess water to evaporate prior to placement of floor coverings.
- G.
 - 1. Refer to floor covering product manufacturer submittals for requirements.
- H. Cold-Weather Placement: Comply with ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- I. Hot-Weather Placement: Comply with ACI 305 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Broom Finish: Apply a broom finish to exposed concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306 for cold-weather protection and ACI 305 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing

operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - b. Curing compound to be applied only in locations permitted or required.

3.13 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.14 JOINT FILLING

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

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Exposed reinforcing steel shall be mechanically cleaned using sandblasting or waterblasting methods. Reinforcing steel shall be free from rust, grease, or other bond-inhibiting coating.
- F. Repairs of depths greater than 3 inches are not covered by this specification. Notify Engineer if such conditions are discovered for further direction of repair methods and products.

- G. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- H. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Unit Weight: ASTM C 567, equilibrium unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 6. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Measure floor and slab flatness and levelness according to ASTM E 1155 within 72 hours of finishing.

END OF SECTION 03 3000

SECTION 05 5000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

1.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 "Structural Welding Code - Steel."

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.5 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.
- D. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches unless otherwise indicated.
 - 2. Material: Cold-rolled steel, ASTM A 1008, structural steel, Grade 33; 0.0528-inch minimum thickness; unfinished.
- E. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3.

- G. Lag Screws: ASME B18.2.1.
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1.
- J. Lock Washers: Helical, spring type, ASME B18.21.1.
- K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- L. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- M. Post-Installed Anchors: Chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3,000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.

- C. Galvanize miscellaneous framing and supports where indicated.

2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.9 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.10 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.12 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink, nonmetallic grout in all locations unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

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SECTION 07 8413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
- C. Qualification Data: For qualified Installer.
- D. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) FM Global in its "Building Materials Approval Guide."

1.4 PROJECT CONDITIONS

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

1.5 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

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. Grace Construction Products.
 - 2. Hilti, Inc.
 - 3. Johns Manville.
 - 4. Nelson Firestop Products.
 - 5. 3M Fire Protection Products.
 - 6. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 7. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479.
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479.
 - 1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. 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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.

- b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
- c. Fire-rated form board.
- d. Fillers for sealants.
- 2. Temporary forming materials.
- 3. Substrate primers.
- 4. Collars.
- 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. 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.
- G. 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.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping 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: Clean out openings immediately before installing penetration firestopping 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.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete or masonry.
- B. Priming: 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.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping 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 fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.

- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

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 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 is 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 and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 8413

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SECTION 07 9200 - JOINT SEALANTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
1. Silicone joint sealants.
 2. Latex joint sealants.
 3. Acoustical joint sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.4 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS**2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. Sika Corporation, Construction Products Division; SikaSil-C990.
 - d. Tremco Incorporated; Spectrem 1.
- B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; NS Parking Structure Sealant
 - b. May National Associates, Inc.; Bondaflex Sil 728 NS.
 - c. Sika Corporation; Sikasil 728 NS.
- C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. Tremco Incorporated; Tremsil 200 Sanitary.

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolac.
 - b. Bostik, Inc.; Chem-Calk 600.
 - c. Tremco Incorporated; Tremflex 834.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20 FTR or AIS-919.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - c. Tremco Incorporated; Tremco Acoustical Sealant.

2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type O (open-cell material), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Perimeter joints at equipment and louvers.
 - b. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings.
 - c. Tile control and expansion joints.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors.
 - e. Other joints as indicated.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 2. Silicone Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

END OF SECTION 07 9200

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SECTION 09 21 16
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 06 10 00 - Rough Carpentry: Building framing and sheathing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- D. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- E. 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 1/32 inch.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 51 00
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".

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

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SECTION 230130.52

EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.

1.2 DEFINITIONS

- A. ACAC: American Council for Accredited Certification.
- B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
- C. ASCS: Air systems cleaning specialist.
- D. CESB: Council of Engineering and Scientific Specialty Boards.
- E. CMI: Certified Microbial Investigator.
- F. CMC: Certified Microbial Consultant.
- G. CMR: Certified Microbial Remediator.
- H. CMRS: Certified Microbial Remediation Supervisor.
- I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
- J. IEP: Indoor Environmental Professional.
- K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.
- L. NADCA: National Air Duct Cleaners Association.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For an ASCS.

B. Field Quality-Control Reports:

1. Project's existing conditions.
2. Evaluations and recommendations, including cleanliness verification.
3. Strategies and procedures plan.

1.5 CLOSEOUT SUBMITTALS

A. Post-Project report.

1.6 QUALITY ASSURANCE

A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified as an ASCS by NADCA.

B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

C. Cleaning Conference: Conduct conference at Project site.

1. Review methods and procedures related to HVAC air-distribution system cleaning, including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS

2.1 HVAC CLEANING AGENTS

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. Apex Engineering Products Corporation.
2. BBJ Environmental Solutions.
3. Goodway Technologies Corporation.
4. Nu-Calgon.
5. QuestVapco Corporation.

B. Description:

1. Formulated for each specific soiled coil condition that needs remedy.
2. Will not corrode or tarnish aluminum, copper, or other metals.

2.2 ANTIMICROBIAL SURFACE TREATMENT

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. Bio-Cide International, Inc.
 2. Contec, Inc.
 3. Ecolab, Inc.
- B. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.
1. Formulated to kill and inhibit growth of microorganisms.
 2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.
 3. Have no residual action after drying, with zero VOC off-gassing.
 4. OSHA compliant.
 5. Treatment shall dry clear to allow continued visual observation of the treated surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR.
- C. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures. At a minimum, include the following:
1. Supervisor contact information.
 2. Work schedule, including location, times, and impact on occupied areas.
 3. Methods and materials planned for each HVAC component type.
 4. Required support from other trades.
 5. Equipment and material storage requirements.
 6. Exhaust equipment setup locations.
- D. Existing Conditions Report: Prepare a written report that documents existing conditions of the systems and equipment. Include documentation of existing conditions, including inspection results, photo images, laboratory results, and interpretations of the laboratory results by an IEP.
1. Prepare written report listing conditions detrimental to performance of the Work.
- E. Proceed with work only after conditions detrimental to performance of the Work have been corrected.
- F. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- G. Comply with NADCA ACR, "Guidelines for Constructing Service Openings in HVAC Systems" Section.
- H. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

- A. Comply with NADCA ACR, including items identified as "recommended," "advised," and "suggested."
- B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.
- C. Remove non-adhered substances and deposits from within the HVAC system.
- D. Complete cleaning in accordance with Owner-Contractor agreed-upon scope of work.
- E. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.
- F. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- G. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.
- H. Control odors and mist vapors during the cleaning and restoration process.
- I. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- J. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- K. Clean all air-distribution devices, registers, grilles, and diffusers.
- L. Clean non-adhered substance deposits according to NADCA ACR and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- M. Air-Distribution Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).

- N. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- O. Mechanical Cleaning Methodology:
1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.
 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
 - c. Fibrous materials that become wet shall be discarded and replaced.
- P. Coil Cleaning:
1. See NADCA ACR, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing coil cleaning verification.
 2. Coil drain pans shall be subject to NADCA ACR, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
 3. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
 4. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations.
 5. Rinse thoroughly with clean water to remove any latent residues.
- Q. Application of Antimicrobial Treatment:
1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory accredited by AIHA-LAP with an EMLAP certificate, and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.

2. Apply antimicrobial treatments and coatings after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Microbial remediation shall be performed by a qualified CMR and CMRS.

3.3 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Verification of Coil Cleaning: Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 1. Written documentation of the success of the cleaning.
 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 3. Surface comparison test results if required.
 4. Gravimetric analysis (nonporous surfaces only).
 5. System areas found to be damaged.

3.4 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening.
- C. Reseal fibrous-glass ducts.
- D. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing.
- E. Replace damaged insulation.
- F. Ensure that closures do not hinder or alter airflow.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- H. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

- I. Measure air flows through air-distribution system.
- J. Measure static-pressure differential across each coil.

3.5 PROJECT CLOSEOUT

A. Post-Project Report:

- 1. Post-cleaning laboratory results if any.
- 2. Post-cleaning photo images.
- 3. Post-cleaning verification summary.

B. Drawings:

- 1. Deviations of existing system from Owner's record drawings.
- 2. Location of service openings.

END OF SECTION 230130.52

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - c. Multizone systems.
2. Testing, adjusting, and balancing of equipment.
3. Testing, adjusting, and balancing of existing HVAC systems and equipment.
4. Duct leakage tests verification.
5. HVAC-control system verification.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.
- L. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- Q. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
1. Motors.
 2. Fans and ventilators.
 3. Terminal units.
 4. Air-handling units.
 5. Heating and ventilating units.
 6. Rooftop air-conditioning units.
 7. Dedicated outdoor-air units.
 8. Packaged air conditioners.
 9. Split-system air conditioners.
 10. Heat pumps.
 11. Coils.
 12. Fan coil units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.

- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
 - a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

- a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Balance the return-air ducts and inlets.
 - b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls Contractor.
9. Verify final system conditions as follows:
 - a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
 - b. Re-measure and confirm that total airflow is within design.
 - c. Re-measure final fan operating data, speed, volts, amps, and static profile.
 - d. Mark final settings.
 - e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
 - f. Verify tracking between supply and return fans.

3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Position the unit's automatic zone dampers for maximum flow through the cooling coil.
- B. The procedures for multizone systems will utilize the zone balancing dampers to achieve the indicated airflow within the zone.
- C. After balancing, place the unit's automatic zone dampers for maximum heating flow. Retest zone airflows and record any variances.

- D. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air and relief-air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- E. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- F. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlet and outlet airflow.
 - 3. Adjust each inlet and outlet for specified airflow.
 - 4. Re-measure each inlet and outlet after they have been adjusted.
- G. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.9 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.10 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.11 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
 - 2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
 - 3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 4. Check the refrigerant charge.
 - 5. Check the condition of filters.
 - 6. Check the condition of coils.
 - 7. Check the operation of the drain pan and condensate-drain trap.
 - 8. Check bearings and other lubricated parts for proper lubrication.
 - 9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the airflow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.13 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 5 percent.
 - 4. Chilled-Water Flow Rate: Plus or minus 5 percent.
 - 5. Condenser-Water Flow Rate: Plus or minus 5 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.14 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.

2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Heating coil, dry-bulb conditions.
 - e. Face and bypass damper settings at coils.
 - f. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - g. Variable-frequency controller settings for variable-air-volume systems.
 - h. Settings for pressure controller(s).
 - i. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Balancing stations.
 5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.

- g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
- 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Inlet and discharge static pressure in inches wg.
 - e. For each filter bank, filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
 - j. Outdoor airflow in cfm.
 - k. Return airflow in cfm.
 - l. Outdoor-air damper position.
 - m. Return-air damper position.
 - n. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - o. Return-air, wet- and dry-bulb temperatures in deg F.
 - p. Entering-air, wet- and dry-bulb temperatures in deg F.
 - q. Leaving-air, wet- and dry-bulb temperatures in deg F.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
- 2. Motor Data:

- a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan speed.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System fan and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- H. Air-Terminal-Device Reports:
1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.

- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space wet- and dry-bulb temperature in deg F.
- h. Leaving-air, wet- and dry-bulb temperatures in deg F.

I. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.16 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Wind Performance: Ducts are to withstand the effects of wind determined in accordance with to ASCE/SEI 7.
- D. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- F. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- G. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elgen Manufacturing.
 - b. GreenSeam.
 - c. Linx Industries; a DMI company (formerly Lindab).
 - d. MKT Metal Manufacturing.
 - e. McGill AirFlow LLC.
 - f. Nordfab Ducting.
 - g. SEMCO, LLC; part of FlaktGroup.
 - h. SHAPE Manufacturing Inc.
 - i. Set Duct Manufacturing.
 - j. Sheet Metal Connectors, Inc.

- k. Spiral Manufacturing Co., Inc.
 - l. Stamped Fittings Inc.
 - m. Ductmate Industries, Inc; a DMI company.
- B. Source Limitations: Obtain single-wall round and flat oval ducts and fittings from single manufacturer.
- C. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- D. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- E. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- F. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G60 G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- D. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
 - 2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: White.
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- G. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed; SAINT-GOBAIN.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Sekisui Voltek, LLC.
 - 2. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
 - 3. Maximum Thermal Conductivity:

- a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
4. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
- B. Insulation Pins and Washers:
 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

- a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Sealant: Modified styrene acrylic.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 6. Service: Indoor and outdoor.
 7. Service Temperature: Minus 40 to plus 200 deg F.
 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Base: Synthetic rubber resin.
 3. Solvent: Toluene and heptane.
 4. Solids Content: Minimum 60 percent.
 5. Shore A Hardness: Minimum 60.
 6. Water resistant.
 7. Mold and mildew resistant.

8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 9. Service: Indoor or outdoor.
 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.

2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.

9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
 - 5. Test for leaks before applying external insulation.
 - 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 7. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. Use service openings for entry and inspection.
 - 1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- E. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- F. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- G. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 16.
- d. SMACNA Leakage Class for Round and Flat Oval: 8.

2. Ducts Connected to Constant-Volume Air-Handling Units:

- a. Pressure Class: Positive 3-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class for Rectangular: 8.
- d. SMACNA Leakage Class for Round and Flat Oval: 4.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

- a. Pressure Class: Positive 4-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 4.
- d. SMACNA Leakage Class for Round and Flat Oval: 2.

4. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive 4-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 4.
- d. SMACNA Leakage Class for Round and Flat Oval: 2.

- C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
 3. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- D. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
 3. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Type 304, stainless steel sheet, No. 4 finish.
 - b. Concealed: Type 304, stainless steel sheet, No. 2D finish.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 4-inch wg.
 - e. Airtight/watertight.
 4. Ducts Connected to Dishwashers, Dishwasher Hoods, and Other High-Humidity Locations:
 - a. Type 304, stainless steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Concealed: No. 2D finish.

- d. Welded longitudinal seams; welded or flanged transverse joints with watertight EPDM gaskets.
 - e. Pressure Class: Positive or negative 3-inch wg.
 - f. Airtight/watertight.
 - 5. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure; A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
 - 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- F. Intermediate Reinforcement:
- 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 - 2. Stainless Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- G. Liner:
- 1. Transfer Ducts: Fibrous glass, Type I, 2 inch thick.
- H. Double-Wall Duct Interstitial Insulation:

1. Supply-Air Ducts: 2 inch thick.
2. Return-Air Ducts: 2 inch thick.
3. Exhaust-Air Ducts: 1 inch thick.

I. Elbow Configuration:

1. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Duct-mounted access doors.
 - 5. Duct access panel assemblies.
 - 6. Flexible connectors.
 - 7. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.
- B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance; MESTEK, Inc.
 - b. Aire Technologies, Inc.; DMI Companies.
 - c. American Warming and Ventilating (AWV); Mestek, Inc.
 - d. Arrow United Industries; Mestek, Inc.
 - e. Cesco Products; MESTEK, Inc.
 - f. Greenheck Fan Corporation.
 - g. Lloyd Industries, Inc.
 - h. McGill AirFlow LLC.
 - i. NCA Manufacturing, Inc.; Metal Industries, Inc.
 - j. Nailor Industries Inc.
 - k. Pottorff.
 - l. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - m. Safe Air - Dowco.
 - n. United Enertech Corp.
 - o. Vent Products Co., Inc.
 - 2. Performance:

- a. Leakage Rating Class I: Leakage not exceeding 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 4. Frames:
 - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16 gauge thick.
 6. Blade Axles: Nonferrous metal.
 7. Bearings:
 - a. Stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 8. Tie Bars and Brackets: Galvanized steel.
 9. Locking device to hold damper blades in a fixed position without vibration.
- B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating (AWV); Mestek, Inc.
 - b. Arrow United Industries; Mestek, Inc.
 - c. Cesco Products; MESTEK, Inc.
 - d. Linx Industries; a DMI company (formerly Lindab).
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - h. Safe Air - Dowco.
 - i. United Enertech Corp.
 2. Performance:
 - a. Leakage Rating Class I: Leakage not exceeding 4 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 4. Frames:
 - a. Hat-shaped, 0.10-inch-thick, aluminum sheet channels.
 - b. Flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
 6. Blade Axles: Nonferrous metal.
 7. Bearings:
 - a. Stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 8. Tie Bars and Brackets: Aluminum.
 9. Locking device to hold damper blades in a fixed position without vibration.
- C. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance; MESTEK, Inc.
 - b. American Warming and Ventilating (AWV); Mestek, Inc.
 - c. Arrow United Industries; Mestek, Inc.
 - d. Cesco Products; MESTEK, Inc.
 - e. Greenheck Fan Corporation.
 - f. Nailor Industries Inc.
 - g. Pottorff.
 - h. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - i. Safe Air - Dowco.
 - j. Vent Products Co., Inc.
 2. Performance:
 - a. AMCA Certification: Test and rate in accordance with AMCA 511.
 3. Construction:
 - a. Linkage: Out of airstream.

- b. Suitable for horizontal or vertical airflow applications.
 - 4. Frames:
 - a. Hat, U, or angle shaped.
 - b. Thickness: 16-gauge galvanized sheet steel.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel; 16 gauge thick.
 - 6. Blade Edging Seals:
 - a. Closed-cell neoprene.
 - 7. Blade Jamb Seals: Flexible metal compression type.
 - 8. Blade Axles: Nonferrous metal.
 - 9. Bearings:
 - a. Stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 - 10. Tie Bars and Brackets: Galvanized steel.
 - 11. Locking device to hold damper blades in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance; MESTEK, Inc.
 - b. American Warming and Ventilating (AWV); Mestek, Inc.
 - c. Arrow United Industries; Mestek, Inc.
 - d. Cesco Products; MESTEK, Inc.
 - e. Pottorff.
 - f. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - g. Safe Air - Dowco.
 - h. United Enertech Corp.
 - i. Vent Products Co., Inc.
 - 2. Performance:
 - a. AMCA Certification: Test and rate in accordance with AMCA 511.
 - 3. Construction:

- a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 - 4. Frames:
 - a. Hat, U, or angle shaped.
 - b. Thickness: 0.08-inch aluminum sheet channels.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.072-inch thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
 - 6. Blade Edging Seals:
 - a. Closed-cell neoprene.
 - b. Inflatable seal blade edging or replaceable rubber seals.
 - 7. Blade Jamb Seals: Flexible metal compression type.
 - 8. Blade Axles: Nonferrous metal.
 - 9. Bearings:
 - a. Stainless steel sleeve.
 - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.
 - 10. Tie Bars and Brackets: Galvanized steel.
 - 11. Locking device to hold damper blades in a fixed position without vibration.
- E. Jackshaft:
- 1. Size: 0.5-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. Damper Hardware:
- 1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 - 2. Include center hole to suit damper operating-rod size.
 - 3. Include elevated platform for insulated duct mounting.

2.3 FLANGE CONNECTORS

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

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. DynAir; a Carlisle Company.
4. Elgen Manufacturing.
5. Ward Industries; a brand of Hart & Cooley, LLC.

- B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.4 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aero-Dyne Sound Control Co.
 2. CL WARD & Family Inc.
 3. Ductmate Industries, Inc; a DMI company.
 4. Duro Dyne Inc.
 5. DynAir; a Carlisle Company.
 6. Elgen Manufacturing.
 7. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- E. Vane Construction:
1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aire Technologies, Inc.; DMI Companies.
 2. Arrow United Industries; Mestek, Inc.
 3. CL WARD & Family Inc.
 4. Cesco Products; MESTEK, Inc.
 5. Ductmate Industries, Inc; a DMI company.

6. Duro Dyne Inc.
 7. Elgen Manufacturing.
 8. Flexmaster U.S.A., Inc.
 9. McGill AirFlow LLC.
 10. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 11. United Enertech Corp.
 12. Ventfabrics, Inc.
 13. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. 24-gauge-thick galvanized steel or 0.032-inch thick aluminum or 24-gauge-thick stainless steel door panel.
 - d. Vision panel.
 - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - f. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
1. Door and Frame Material: Galvanized sheet steel.
 - a. 24-gauge-thick galvanized steel or 0.032 inch-thick aluminum or 24-gauge-thick stainless steel door panel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.

3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0 to 8.0 inches wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.6 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company.
 3. Flame Gard, Inc.
- B. Access panels used in cooking applications:
 1. Labeled compliant to NFPA 96 for grease duct access doors.
 2. Labeled in accordance with UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 16-gauge stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10 inches wg positive or negative.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company.
 3. Duro Dyne Inc.
 4. DynAir; a Carlisle Company.
 5. Elgen Manufacturing.
 6. Ventfabrics, Inc.
 7. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.
- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- J. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- K. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.8 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company.
 3. Duro Dyne Inc.
 4. DynAir; a Carlisle Company.
 5. Elgen Manufacturing.
 6. Hardcast; Carlisle Construction Materials.
 7. United Enertech Corp.
 8. Ventfabrics, Inc.
 9. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.9 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 1. Galvanized Coating Designation: G60 G90.
 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2 finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire and smoke dampers in accordance with UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-ft. spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. For grease ducts, install at locations and spacing as required by NFPA 96.
 - 10. Control devices requiring inspection.

- 11. Elsewhere as indicated.
 - J. Install access doors with swing against duct static pressure.
 - K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 12 by 12 inches.
 - 2. Two-Hand Access: 12 by 12 inches.
 - 3. Head and Hand Access: 18 by 12 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
 - L. Install flexible connectors to connect ducts to equipment.
 - M. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 - N. Install duct test holes where required for testing and balancing purposes.
 - O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
- 3.2 FIELD QUALITY CONTROL
- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

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SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flexible ducts, insulated.
 - 2. Flexible duct connectors.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Flexible ducts, insulated.
 - 2. Flexible duct connectors.
- B. Product Data Submittals: For each type of product.
- C. Shop Drawings: For flexible ducts.
 - 1. Include plans showing locations, mounting details, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D. Comply with ASTM E96/E96M.

2.2 FLEXIBLE DUCTS, INSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ATCO Rubber Products, Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company.
 - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 10 to plus 160 deg F.
 - 5. Insulation R-Value: R6.
 - 6. Vapor-Barrier Film: Aluminized.
- C. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CASCO C.A. Schroeder, Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. JP Lamborn Co.
 - d. Thermaflex; a Flex-Tek Group company.
 - 2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 20 to plus 175 deg F.
 - 5. Insulation R-Value: R6.
 - 6. Vapor-Barrier Film: Aluminized.
- D. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexmaster U.S.A., Inc.
 - b. JP Lamborn Co.
 - c. Thermaflex; a Flex-Tek Group company.
 - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
 - 3. Maximum Air Velocity: 4000 fpm.
 - 4. Temperature Range: Minus 20 to plus 210 deg F.

5. Insulation R-Value: R6.
6. Vapor-Barrier Film: Aluminized.

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION OF FLEXIBLE DUCTS

- A. Install flexible ducts in accordance with applicable details in the following publications:
 1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
 2. NAIMA AH116.
 3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
 4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers and light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Installation:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
 6. Install in accordance with ADC instructions.
- G. Supporting Flexible Ducts:
 1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
 2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.

3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 - 2. Carnes Company.
 - 3. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 - 4. METALAIRE, Inc.
 - 5. Nailor Industries Inc.

6. Price Industries Limited.
 7. Titus; brand of Johnson Controls International plc, Global Products.
 8. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Refer to Mechanical Schedules.
- D. Finish: Baked enamel, color selected by Architect and Owner.
- E. Face Size: Refer to Mechanical Schedules.
- F. Face Style: Three cone.
- G. Mounting: Refer to reflected ceiling plan for mounting type.
- H. Pattern: Adjustable.
- I. Dampers: Radial opposed blade.
- J. Accessories:
1. R6 Insulated Backpan.

2.2 PERFORATED DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
 2. Carnes Company.
 3. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Price Industries Limited.
 7. Titus; brand of Johnson Controls International plc, Global Products.
 8. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: Steel backpan and pattern controllers, with aluminum face.
- D. Finish: Baked enamel, color selected by Architect and Owner.
- E. Face Size: Refer to Mechanical Schedules.
- F. Duct Inlet: Refer to Mechanical Schedules.
- G. Mounting: Refer to reflected ceiling plan for mounting type.
- H. Pattern Controller: Refer to Mechanical Schedules.

- I. Dampers: Opposed blade.
- J. Accessories:
 - 1. Equalizing grid.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

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SECTION 26 05 00

GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work included in this Contract is shown on the drawings and described in these specifications. It consists of furnishing all labor, material, services, supervision and connection of all systems shown and/or specified including the requirements of:

DIVISION	00	-	BIDDING AND CONTRACT REQUIREMENTS
DIVISION	01	-	GENERAL REQUIREMENTS
DIVISION	26	-	ELECTRICAL WORK

- B. Contractor is responsible to review and understand all drawings and all work of all trades to ensure a complete and thorough project.
- C. Provide all labor, tools, materials, equipment, coordination, and plans necessary for installation and proper operation of the electrical systems.
- D. Contract drawings and specifications are complementary and must be so used to ascertain all requirements of the work.

1.2 DEFINITIONS

- A. Provide, furnish, install, and furnish and install shall have the same meaning. That is, the Contractor shall purchase, transport to the site and install all required components of the work unless specifically stated otherwise in the contract documents.
- B. Wiring pertains to raceway, fittings, conductors, terminations, hangers, supports, etc. as required to form a complete system.

1.3 DRAWINGS AND SPECIFICATIONS

- A. The plans are diagrammatic and indicate only the sizes and general arrangement of conduit, devices, and equipment; exact locations of all elements shall be determined as work progresses, in cooperation with the work of other trades. It is not intended to show every item of work or minor piece of equipment, but every item shall be furnished and installed without additional remuneration as necessary to complete the system in accordance with the best practice of the trade.
- B. As previously stated, the exact locations of electrical devices and equipment are diagrammatic. The owner may request for any devices or equipment to be installed at different locations than what is indicated on the drawings in a specific area or room. It is the responsibility of the Electrical Contractor to coordinate the locations of devices in all areas prior to installation.

1.4 APPLICABLE STANDARDS

- A. All equipment shall bear the UL label.
- B. The latest edition of the following minimum standards shall apply wherever applicable:
- | | | |
|----|------|--|
| 1. | ASA | American Standards Association |
| 2. | ASTM | American Society for Testing Materials |
| 3. | ETL | Electrical Testing Laboratories, Inc. |

4. IEEE Institute of Electrical and Electronic Engineers
5. IPCEA Insulated Power Cable for Engineers Association
6. OSHA Occupational Safety and Health Act
7. NEC National Electrical Code
8. NEMA National Electrical Manufacturers Association
9. NESC National Electrical Safety Code
10. NFPA National Fire Protection Association
11. UL Underwriters Laboratories, Inc.
12. Power company standards and regulations.
13. Local and state codes.

- C. In the event there are conflicts between specifications and standards, standards shall govern unless specifications are in excess of standards.

1.5 PERMITS AND INSPECTIONS

- A. Permits: The Contractor shall apply for and pay the cost for any local permits necessary for the work of this contract.
- B. Inspections: The Contractor shall be responsible for obtaining a 3rd party electrical inspection of and the certificate by the approved inspection agency for the entire electrical system.
- C. The undertaking of periodic inspections by the Owner or Engineer shall not be construed as supervision of actual construction. The Owner or Engineer is not responsible for providing a safe place of work for the Contractor, Contractor's employees, suppliers or subcontractors for access, visits, use, work, travel or occupancy by any person.

1.6 CODES AND REGULATIONS

- A. Comply with all applicable rules and regulations of the municipal laws and ordinances and latest revisions thereof. All work shall be done in full conformity with the requirements of all authorities having jurisdiction. Modifications required by the above authorities will be made without additional charges to the Owner. Where alterations to and/or deviations from the Contract Documents are required by the authorities, report the requirements to the Engineer and secure approval before work is started.
- B. Furnish and file with the proper authorities, all drawings required by them in connection with the work. Obtain all permits, licenses, and inspections and pay all legal and proper fees and charges in this connection.
- C. Should any work shown or specified be of lighter or smaller material than Code requires, same shall be executed in strict accordance with the regulations.
- D. Heavier or larger size material than Code requires shall be furnished and installed, if required by the Plans and Specifications.
- E. This Contractor shall have the electrical work inspected from time to time by authorized inspectors. At the completion of the work, the Contractor shall furnish a Certificate of Approval, in triplicate, indicating full approval of the work furnished and installed in this Contract from the local authority having jurisdiction.
- F. Equipment and components parts thereof shall bear manufacturer's nameplate, giving manufacturer's name, size, type and model number or serial number, electrical characteristic to facilitate maintenance and replacements. Nameplates of distributors or contractors are not acceptable.

- G. Engineer will have privilege of stopping any work or use of any material that in his opinion is not being properly installed and each Contractor shall remove all materials delivered, or work erected, which does not comply with Contract Drawings and Specifications, and replace with proper materials, or correct such work as directed by the Engineer, at no additional cost to Owner.
- H. If equipment or materials are installed before proper approvals have been obtained, each Contractor shall be liable for their removal and replacement including work of other trades affected by such work, at no additional cost to Owner, if such items do not meet intent of the Drawings and Specifications.

1.7 RECORD DRAWINGS

- A. The Electrical Contractor shall keep an accurate location record of all underground and concealed piping, and of all changes from the original design. He is required to furnish this information to the Engineer prior to his application for final payment.
 - 1. Submit prior to final acceptance inspection, one complete marked-up set of reproducible engineering design drawings.
 - a. Fully illustrate all revisions made by all crafts in course of work.
 - b. Include all field changes, adjustments, variances, substitutions and deletions, including all Change Orders.
 - c. Exact location of raceways, equipment and devices.
 - d. Exact size and location of underground and under floor raceways and duct banks.
 - 2. These drawings shall be for record purposes for Owner's use and are not considered shop drawings.
- B. At completion of the project, all changes and deviations from the Contract Documents shall be recorded by the Contractor.
- C. An electronic set in PDF format of all operating and maintenance instructions and complete parts lists shall be furnished to the Owner.

1.8 SLEEVES

- A. Sleeves: furnished, set in Electrical Work; built-in under General Construction Work.
- B. Sleeves for Information Technology cabling and other low-voltage system cabling shall be as indicated on the Drawings.
- C. Sleeves shall be as follows:
 - 1. Sleeves in floors and partitions shall be galvanized steel with lock seam joints or a manufactured conduit floor seal.
 - 2. Sleeves of extra heavy cast iron pipe or galvanized steel pipe shall be used in outside walls, foundations, and footing or manufactured compression-type wall seal (waterproof).
 - 3. Conduit sleeves shall be two (2) sizes larger than the conduit passing through it.
 - 4. Terminate sleeves flush with walls, partitions, and ceilings. Sleeves in floor shall terminate 1/4" above floors.
 - 5. Fill space between sleeve and conduit in foundation walls with oakum and caulk with lead on both sides of wall. When using pipe sleeves, fill space between sleeve and pipe with fiberglass blanket insulation when sleeve does not occur in a foundation wall.
 - 6. An approved fire stop seal shall be used when conduits penetrate fire stopping walls and floors (between fire zones).

- D. Set sleeves and obtain review of their locations in ample time to permit pouring of concrete or progressing of other construction work as scheduled.

1.9 CLEANING CONDUIT, EQUIPMENT

- A. Conduit, equipment: thoroughly cleaned of dirt, cuttings, other foreign substances. Should any conduit, other part of systems be stopped by any foreign matter, disconnect, clean wherever necessary for purpose of locating, removing obstructions. Repair work damaged in course of removing obstructions.

1.10 VIBRATION ISOLATION

- A. Vibration isolators shall prevent, as far as practicable, transmission of vibration, noise or hum to any part of building.
- B. Design isolators to suit vibration frequency to be absorbed; provide isolator units of area, distribution to obtain proper resiliency under machinery load, impact.
- C. Wiring and other electrical connections to equipment mounted on vibration isolators; made flexible with minimum 180-degree loop of flexible conduit in order to avoid restraining equipment and short circuiting vibration isolator.

1.11 BALANCED LOAD

- A. It is intended that design and features of the work as indicated will provide balanced load on the feeders and main service. Contractor shall provide material and installation to provide this balance load insofar as possible.
- B. Contractor shall take current and voltage measurements at all panels of at least 1/2 hour. Reconnections of loads shall be made when deemed necessary by the Engineer.

1.12 JOB CONDITIONS

- A. Examine site related work and surfaces before starting work of any Section. Failure to do so shall in no way relieve the Contractor of the responsibility to properly install the new work.
 - 1. Report to the Engineer, in writing, conditions which will prevent proper provision of this work ten (10) days prior to bid date, in time for an addendum to be issued.
 - 2. Beginning work of any Section without reporting unsuitable conditions to the Engineer constitutes acceptance of conditions by the Contractor.
 - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
 - 4. The Contractor is responsible for performing routine maintenance and cleaning of any existing equipment where he is making connections to new work and to the building where his work adds debris.
- B. Connections to existing work:
 - 1. Install new work and connect to existing work with minimum interference to existing facilities.
 - 2. Provide temporary shutdowns of existing services only with written consent of Owner at no additional charges and at time not to interfere with normal operation of existing facilities.
 - 3. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work.
 - 4. Do not interrupt alarm and emergency systems.

5. Connect new work to existing work in neat and acceptable manner.
 6. Restore existing disturbed work to original condition including maintenance of wiring and continuity as required. Replace damaged or rusted conduit to which new equipment is being installed and connected.
- C. Removal and relocation of existing work.
1. Disconnect, remove or relocate electrical material, equipment and other work noted and required by removal or changes in existing construction.
 2. Provide new material and equipment required for relocated equipment.
 3. Disconnect load and line end of conductors feeding existing equipment.
 4. Remove conductors from existing raceways to be rewired.
 5. Remove conductors and cap outlets on raceways to be abandoned.
 6. Cut and cap abandoned floor raceways flush with concrete floor or behind walls and ceilings.
 7. Dispose of removed raceways and wire.
 8. Dispose of removed electrical equipment as directed by Owner. The Owner shall provide a list of equipment of the Contractor of equipment to be delivered to the Owner.

1.13 SPECIAL TOOLS AND LOOSE ITEMS

- A. Furnish to Owner at completion of work:
1. One set of any special tools required to operate, adjust, dismantle or repair equipment furnished under any section of this Division.
 2. "Special Tools": Those not normally found in possession of mechanics or maintenance personnel.
 3. Keys
 4. Redundant components and spare parts.
- B. Deliver items to Owner and obtain receipt prior to approval of final payment.

1.14 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by representative of the Engineer.
- B. Advise Engineer that work is ready for review at following times:
1. Prior to backfilling buried work.
 2. Prior to concealment of work in walls and above ceilings.
 3. When all requirements of contract have been completed.
- C. Neither backfill nor conceal work without Engineer's consent.

1.15 SHOP DRAWING SUBMITTALS

- A. Submit required shop drawings, samples and product information in accordance with Division 1, requirements and as required in the various sections of these specifications.
- B. Submittals shall show evidence of checking by the Contractor for accuracy. Product information (catalog sheets) shall indicate complete catalog number, color, accessories, etc., as well as, name of manufacturer and local distributor or manufacturer's representative.
- C. Incomplete submittals will be rejected.
- D. Additionally, the Contractor will submit data on the following:
1. All electrical equipment including all panelboards and switching devices (disconnects, switches, occupancy sensors, etc.).

2. Any proposed variation in specified wiring plans and circuitry.
 3. All special items and panels, made or constructed specifically for this project, including wiring diagrams, component layout and component data or materials list.
 4. All settings of installed equipment, such as overcurrent protection, overload settings, temperature settings, time settings, etc. This includes equipment provided by other contractors or subcontractors and connected and tested by this Contractor.
- E. All submittals of NON-SPECIFIED equipment and components will be reviewed. It is the submitting Contractor's responsibility to prove compliance and not the Engineer to prove non-compliance. The submitting Contractor will be charged the prevailing wage of the reviewing Engineer for all submittals requiring over one (1) hour to review that were not originally specified.
- F. It is the Contractor's responsibility to provide submittals in an organized and timely manner so as not to delay the project schedule and hamper the work of other trades.
- 1.16 OPERATING INSTRUCTIONS
- A. It shall be the Contractor's responsibility to insure that the Owner's representative is given adequate instruction on the operation of all equipment prior to final payment.
- 1.17 TEMPORARY POWER
- A. The Contractor shall coordinate all temporary power to all trades throughout all phases of construction throughout the duration of this project with the construction manager. This will include but not be limited to temporary lighting, power outlets, temporary elevator operation, controls for temporary heating, and job trailers. Contractor shall be responsible for coordinating temporary power via adjacent building(s) and/or a temporary diesel fired generator and associated fuel costs. Contractor shall coordinate temporary power source with construction manager prior to demolition. Contractor is responsible for all costs associated with temporary power.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials and equipment shall be new and as specified or of equal or better quality.
- B. Basic hardware and miscellaneous items shall meet existing trade standards of quality and shall carry UL or FM listings where applicable.
- C. All equipment supplied shall be the standard equipment of the manufacturer.
- D. Multiple items such as raceways, wiring devices, etc., shall be from the same manufacturer.
- E. Drawings and specifications are based on specific manufacturer's equipment. Therefore, the Contractor shall assume all responsibility, cost and coordination involved in making any necessary revisions to apply another manufacturer's equipment, even though it may be approved as an "equal" item by the Engineer.

PART 3 - EXECUTION

3.1 COORDINATION OF WORK

- A. All work shall be executed in accordance with recognized standards of workmanship. All work shall be installed in a neat and orderly manner.
- B. The Contractor shall exchange information with other Contractors and the Owner in order to insure orderly progress of the work.
- C. The Contractor must contact the Owner's representative and schedule all work ten (10) days prior to start.
- D. The Contractor shall check for possible interference before installing any items. If any work is installed, and later develops interference with other features of the design, the Contractor will be responsible to make such changes to eliminate the interference.

END OF SECTION 26 05 00

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.
- C. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. Encore Wire Corporation.
 - 4. General Cable Corporation.
 - 5. Senator Wire & Cable Company.
 - 6. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- B. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- C. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed and knockout seals.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. For stranded conductors, install crimp on fork terminals for device terminations if device does not have pressure terminals. Do not place bare stranded conductors directly under screws unless device has pressure terminals.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior wall assemblies. Comply with requirements in Section 260500 "General Provisions for Electrical Work."

3.6 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to an approved UL-listed method.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes: Grounding systems and equipment.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.06 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Ground rods, grounding bars, grounding clamps, and accessories:
 - 1. Erico.
 - 2. Harger.
 - 3. Southern Grounding.

4. Galvan.
- B. Exothermic welding systems:
 1. Cadweld.
 2. Thermoweld.
 3. Ultrashot.

2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.03 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

- B. Underground Grounding Conductors: Install bare tinned-copper conductor, size as shown on Drawings minimum.
 - 1. Bury at least 30 inches below grade.
- C. Grounding Bus: Install in electrical and communications equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Exothermically welded connectors except as otherwise indicated.
 - 3. Connections to Structural Steel: Exothermically welded connectors.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Install two parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds maximum resistance specified herein.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 - 1. For telephone, alarm, voice and data, and other communication equipment, provide No. 3/0 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.

3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Where metal duct is directly connected to unit, check continuity and bond as required. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.05 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
1. Electrical Service Disconnect: 15 ohms.
 2. Transformers: 15 ohms.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate installation of equipment supports.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Cooper B-Line, Inc.; a division of Cooper Industries.
- 2) Empire Tool and Manufacturing Co., Inc.
- 3) Hilti Inc.
- 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To New Concrete: Bolt to concrete inserts.
 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 3. To Existing Concrete: Expansion anchor fasteners.
 4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts and Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount pull and junction boxes, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 0533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Tele-power poles.
 - 6. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquid-tight flexible metal conduit.
- E. RMC: Galvanized steel rigid metal conduit.
- F. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney; a brand of EGS Electrical Group.
 - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.

7. Republic Conduit.
 8. Robroy Industries.
 9. Southwire Company.
 10. Thomas & Betts Corporation.
 11. Western Tube and Conduit Corporation.
 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RMC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC, RMC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.
 6. Condux International, Inc.
 7. Electri-Flex Company.
 8. Kraloy.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Niedax-Kleinhuis USA, Inc.
 11. RACO; a Hubbell company.
 12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. RNC: Type EPC-40-PVC and 80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold/Legrand.
 - 3. Panduit.
- C. Description:
 - 1. Two-piece surface raceway, with separate channels for power wiring and voice/data communication cabling.
 - 2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
 - 3. Raceway Material: Steel with finish to be selected by Owner and Architect.

2.5 TELE-POWER POLES

- 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. Wiremold/Legrand 25DTP.
 - 2. Panduit.
 - 3. Hubbell.
- B. Material: Steel with gray finish.

- C. Description:
 - 1. 2.5-inch square raceway, with separate channels for power wiring and voice/data communication cabling.
 - 2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Devices: Types and locations per Drawings. Comply with Section 262726 "Wiring Devices" and 271500 "Communication Horizontal Cabling".
- E. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell Company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep unless otherwise noted.

- J. Gangable boxes are allowed.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: RMC.
 - 2. Concealed Conduit, Aboveground: RMC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or Type 4.
 - 5. Underground Conduit: RNC, Type EPC-40-PVC.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Physical Damage (8'-0" AFF and below): RMC.
 - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 5. Damp or Wet Locations: RMC.
 - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use compression, expansion gland type, steel fittings. Comply with NEMA FB 2.10.
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings or approved by Owner and Engineer based on field conditions.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

- I. All conduit installed in or under the building floor slab shall be of material specified herein. Conduits in the concrete floor slabs on grade shall be installed inside the slab above the vapor barrier where possible and shall be covered with a minimum of 2" of concrete. If metallic conduits are installed below the floor slab and vapor barrier they shall be coated with two coats of coal tar bitumastic.
- J. Conduit underground outside the building shall be of material specified herein. Metallic conduits shall be coated with two coats of coal tar bitumastic. Conduits containing conductors at voltages of 120 volts or higher (phase to ground) shall be installed a minimum of 48" below grade. All underground wires or conduits shall be buried with a warning tape installed 24" above the conduit or cable.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
 - 5. Change from RNC to EMT or RMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- 3.3 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies using an approved UL-listed method. Refer to Section 078413 "Penetration Firestopping".
- 3.4 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 0533

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SECTION 26 05 33.16
FLOOR BOXES FOR AV SYSTEMS

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, and Division 01 – General Requirements apply.

1.02 SECTION INCLUDES

- A. AV floor boxes.

1.03 RELATED SECTIONS

- A. Section 07 84 13 - Penetration Firestopping Devices.
- B. Division 26 - Electrical: Electrical systems and components.
- C. Division 27 - Communications: Communications and audio-video systems and components.
- D. Division 28 - Electronic Safety and Security: Security systems and components.

1.04 SUBMITTALS

- A. Product Data: Submit for electrical floor boxes.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacture of electrical floor boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide electrical floor boxes and fittings produced by a manufacturer listed in this section.
- B. Electrical Boxes and Fittings: Comply with requirements of applicable local codes, NEC, UL, ETL, and NEMA Standards pertaining to boxes and fittings. Listed and labeled in accordance with NFPA 70, Section 300-21.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver electrical floor boxes in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: The design for electrical floor boxes and fittings is based on Evolution Series Floor Boxes manufactured by Legrand/Wiremold, 60 Woodlawn Street, West Hartford, CT 06110; toll-free 800-621-0049, telephone 860-233-6251, fax 860-232-2062; Web Site: www.legrand.us/wiremold. Provide this product or equal by:
 - 1. Hubbell.

2.02 FLOOR BOXES

- A. Refer to AV Box Schedule on Drawings for specific types.
- B. Classification and Use: Floor boxes shall have been examined and tested by Underwriters Laboratories Inc. to meet UL514A and/or UL514C and Canadian Standard C22.2, No. 18.1-04 and 18.2-06 and bear the U.S. and Canadian UL Listing Mark. Floor boxes shall also have been tested by Underwriters Laboratories Inc. and classified for fire resistance and bear the U.S. and Canadian UL Classification Mark. Devices shall be classified for use in 2-hour rated, unprotected reinforced concrete floors and 2-hour rated floors employing unprotected steel floor units and concrete toppings (D900 Series Designs) or concrete floors with suspended ceilings (fire resistive designs with suspended ceilings should have provisions for accessibility in the ceiling below the floor boxes). Floor boxes shall also conform to the standards set in Section 300-21 of the National Electrical Code. Floor boxes shall meet UL scrub water requirements, but are not suitable for wet or damp locations, or other areas subject to saturation with water or other liquids such as commercial kitchens. Floor boxes shall also have been evaluated by UL to meet the applicable U.S. and Canadian safety standards for scrub water exclusion when used on tile, bare concrete, terrazzo, wood, and carpet covered floors. Floor boxes shall be suitable for use in air handling spaces in accordance with Section 300-22 (C) of the National Electrical Code.
- C. Floor Boxes, General: Boxes shall be compatible with complete line of Ortronics® workstation connectivity outlets and modular inserts.
 - 1. Floor boxes provide the interface between power, communication and audio/video (A/V) cabling in above-grade floors, on-grade concrete floors, raised floors, wood floors, and fire-classified floors and the workstation or activation location where power and communication and/or A/V device outlets are required. Boxes shall provide recessed device outlets that will not obstruct the floor area. Refer to Drawings for size and types.
 - 2. Floor boxes shall permit all wiring to be completed at floor level. The FC models shall be used as defined by the UL Fire Resistance Directory at a minimum spacing of two (2) ft [610mm] on center.
- D. Model EFB8S-OG Floor Boxes: Manufactured from stamped steel approved for use in above grade and on-grade floor applications. Boxes shall have the ability to accept a component (EFB610-CTR) that will allow the box to be installed in polished concrete or terrazzo floors. Boxes shall be painted with a fusion-bonded epoxy designed for use on metal reinforcement bar and related accessories before encapsulation in concrete, and be approved for use on-grade and above grade floors. Boxes shall be 15-3/16" L x 12-5/8" W x 6-1/16" H [385mm x 321mm x 154mm]. Provide boxes with eight (8) independent wiring compartments that allow for up to eight (8) duplex receptacles, communication and/or audio/video services. Boxes shall have removable and relocatable dividers to permit custom configuration of compartments as well as permit feed to adjacent compartments. Boxes shall permit feed to compartments on the opposite side of the box through a tunnel. Each of the four (4) outer compartments shall have a minimum wiring capacity of 28-in³ [455ml]. Each of the four (4) center compartments shall have a minimum wiring capacity of 34-in³ [455ml]. Each of the eight (8) compartments shall have a minimum depth of 3-1/2" [89mm] behind the plate. Provide boxes with removable compartments to facilitate installation. The compartments shall be removable from the top of the floor box. Provide boxes with two (2) cable guides to organize and maintain the cables egress out of the box. The box shall contain the following number of knockouts: 12 1-inch trade size, six (6) 1-1/4-inch trade size, and four (4) 2-inch trade size. Boxes shall be fully

adjustable, accommodating a maximum 2-inch [51mm] pre-concrete pour and a maximum 1/2" [12.7mm] post-concrete pour adjustment. The box shall be able to accept standard size single gang (2-3/4" x 4-1/2"), double gang (2-3/4" x 4-1/2"), and triple gang (6-3/8" x 4-1/2") wall plates. Include mounting brackets with the boxes that will accommodate 15 amp, 20 amp straight blade, 20 amp turn loc, 30 amp straight blade and 30 amp turn loc receptacles. Boxes shall have the ability to accommodate a bracket (EFB-50A) allowing for one (1) 50-amp receptacle. Boxes shall also accommodate Ortronics® workstation connectivity and modular adapters, a variety of audio/video devices from most manufacturers, and other open system devices.

2.03 ACTIVATION COVERS

- A. Evolution EFB610BT and EFB610CT Series Covers: Manufactured of die-cast aluminum. Activation covers shall be available in surface mount and flush versions. Provide covers with two (2) gaskets (one (1) for carpet and one (1) for tile) to go under the trim flange to maintain scrub watertightness. Covers shall be 16-15/16" x 12-1/2" x 3/16" [430mm x 318mm x 4mm]. Covers shall be available with a carpet recess area or a solid lid. Secure the cover to the flange and enable cover to rotate greater than 180 degrees to reduce trip hazards and provide maximum amount of working space. Provide covers with spring-loaded self-closing slide egress doors to reduce egress opening when cables are exiting and reduce trip hazards. Each of the two (2) egress openings shall have a minimum of 4-in² [102mm²], or a minimum of 8-in² [203mm²] per cover assembly. Cover finish shall be available in six (6) powder coated finishes; finish to be selected by Architect.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions under which boxes and fittings are to be installed. Notify the Architect/Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

3.03 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect boxes until acceptance.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Identification for wiring devices.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

- B. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.02 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.03 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.04 WIRING DEVICE LABELS

- A. Embossed adhesive tape, with ¼-inch black-filled letters on white background.

2.05 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed. Minimum letter height shall be 3/8 inch (10 mm). Refer to detail on Drawings.

2.06 FLOOR MARKING TAPE

- A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.07 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black.

- C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 - 5. Color: Black except where used for color-coding.

2.08 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

- A. Nameplates for Conduits and Raceways Carrying Circuits at 600 V or Less:
 - 1. Provide nameplate label on all conduits and raceways longer than 6 feet, at ends of conduit, where connected to panels and equipment, and at both sides of penetrations through walls or ceilings.
 - 2. Legend:
 - a. Power conduits: Panel/circuit number and voltage system, Black lettering on white background.
Example: RPA1-7 120V
 - b. Fire Alarm: FIRE ALARM. Red lettering on white background.

- B. Accessible Conduits and Raceways within Buildings:
 - 1. Identify the covers of each junction and pull box with permanent marker with the panel and circuit number and system voltage.
 - 2. Paint junction boxes, pull boxes, and conduit fittings. Colors shall be:
 - a. Fire Alarm - Red, and label as FIRE ALARM.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Neutral conductors shall be White. When two or more neutrals are located in one conduit, individually identify each with the circuit number with which it is associated. Sharing of Neutral Conductors is not permitted.
 - e. Equipment Grounding Conductors:
 - 1) 6 AWG and smaller: Green
 - 2) 4 AWG and larger: Identify with green tape at both ends and at visible points including junction and pull boxes.
 - f. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install wire marker for each conductor at panelboard, gutters, pull boxes, outlet and junctions boxes, and at each load connected. Mark with panel and circuit number.
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
- 2. Equipment to Be Labeled: Equipment label shall be engraved, laminated acrylic or melamine label. Label all electrical equipment. Refer to Detail on Drawings.
 - a. Label Colors and Contents: Refer to Detail on Drawings.
 - b. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Label with panel name, voltage, and source where fed from. Label each circuit breaker with manufacturer provided circuit number following NEMA standard numbering. Panel directory shall match numbering of breakers.

END OF SECTION 26 05 53

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy sensors.
 - 2. Wall-box dimmers.
 - 3. Photoelectric switches.
 - 4. Lighting contactors.
 - 5. Time switches.
- B. Related Requirements:
 - 1. Section 26 27 26 "Wiring Devices" for manual light switches, and color/finish of devices.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 INDOOR OCCUPANCY SENSORS

- 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. Cooper Industries, Inc.
 - 2. Lightolier Controls.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Lutron Electronics Co., Inc.
 - 5. Sensor Switch, Inc.
 - 6. Square D; a brand of Schneider Electric.
 - 7. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - d. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 - e. Bypass Switch: Override the "on" function in case of sensor failure.
 - f. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
 - g. Dual Relay Units: Shall have provisions for setting both relays to turn on when occupancy is detected. Units that allow only one relay to default to "on" are not acceptable.
- C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 4. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 5. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

2.02 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- 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. Cooper Industries, Inc.
 2. Leviton Mfg. Company Inc.
 3. Lightolier Controls.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Lutron Electronics Co., Inc.
 6. Sensor Switch, Inc.
 7. Square D; a brand of Schneider Electric.

8. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA LED at 120 V and 1200-VA LED at 277 V.
 4. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft.
 5. Sensing Technology: Dual technology (PIR and ultrasonic).
 6. Switch Type: Single-relay or dual-relay, as indicated on drawing.
 - a. Dual-Relay Units: Shall have provisions for setting both relays to turn on when occupancy is detected. Units that allow only one relay to default to "on" are not acceptable.
 - b. Voltage: Match the circuit voltage.
 - c. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 - d. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 - e. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
 - f. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 - g. Color/finish shall match that of other wiring devices in the project.

2.03 WALL-BOX DIMMERS

- 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. Cooper Industries, Inc.
 2. Leviton Mfg. Company Inc.
 3. Lightolier Controls.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Lutron Electronics Co., Inc.
 6. Sensor Switch, Inc.
 7. Watt Stopper.
- B. Dimmer Switches: Specification grade, modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- C. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472. Standard toggle-type switch with small adjacent slider is not acceptable.
- D. Coordinate dimmer type with lighting fixtures being controlled. Provide compatible type of dimmer (e.g., 0-10V, forward phase control, etc.) as required.
- E. Power rating: Match load on drawings; 600 watts minimum.

2.04 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.
 - 2. Intermatic, Inc.
 - 3. NSi Industries LLC; TORK Products.
 - 4. Tyco Electronics; ALR Brand.
 - 5. Paragon.
- B. Description: Solid state, with SPST or DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 - 3. Time Delay: Fifteen second minimum, to prevent false operation.
 - 4. Surge Protection: Metal-oxide varistor.
 - 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.05 LIGHTING CONTACTORS

- 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. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Corporation.
 - 4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
 - 5. Square D; a brand of Schneider Electric.
- B. Description: Electrically operated and electrically held, combination-type lighting contactors, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.06 TIME SWITCHES

- 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. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Invensys Controls.
 4. Leviton Mfg. Company Inc.
 5. NSi Industries LLC; TORK Products.
 6. Tyco Electronics; ALR Brand.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: As indicated on drawings.
 3. Contact Rating: As indicated on drawings.
 4. Programs: As indicated on drawings.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 6. Astronomic Time: All channels.
 7. Automatic daylight savings time changeover.
 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.07 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Sensors: Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Sensors: Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- C. Dimmers:
 1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

3.02 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.03 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

3.05 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.03 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; Schneider Electric.
 - 2. Eaton.
 - 3. ABB.
 - 4. Siemens.

2.02 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Aluminum.

2.03 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilating, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- E. Taps for Transformers Smaller Than 3 kVA: None.
- F. Taps for Transformers 7.5 to 24 kVA: Two 5 percent tap above and two 5 percent tap below normal full capacity.

- G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.
- I. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- J. Wall Brackets: Manufacturer's standard brackets.
- K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.04 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.05 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.03 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Remove and replace units that do not pass tests or inspections and retest as specified above.
- C. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

B. MAINTENANCE MATERIAL SUBMITTALS

- C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys: Two spares for each type of panelboard cabinet lock.
 2. Circuit Breakers Including GFCI Types: Two spares for each panelboard.
 3. Replaceable SPD Protection Modules: One of each size and type installed.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations:
1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than ten days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Owner's written permission.
 3. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush or Surface-mounted cabinets as indicated on drawings.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Front: Secured to box with with bolts (trim clamps no allowed). For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - d. Hinged Front Cover: Entire front trim hinged to box and with piano-hinged door within piano-hinged trim cover.
 - e. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 - f. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - g. Finishes:
 - 1) Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - 2) Back Boxes: Galvanized steel.
 - h. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Phase- and Neutral-Bus Material: Copper or Tin-plated, high-strength, electrical-grade aluminum alloy.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box or manufacturer's standard bolted ground bar.
 - 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads. Provide where indicated on Drawings.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum circuit-breaker line connections.

2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Provide where indicated on Drawings:
 - a. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - b. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - c. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully-rated. Series-rating is not allowed.

2.02 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. Eaton.
 3. ABB.
 4. Siemens.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Piano-hinged door, secured with vault-type latch with tumbler lock; keyed alike.
 1. For doors more than 36 inches high, provide two latches, keyed alike.
 2. Mains: Circuit breaker or Lugs only.
 3. Branch Overcurrent Protective Devices: Bolt-on or plug-in circuit breakers.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. Eaton.
 3. ABB.
 4. Siemens.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- E. Doors: Door-in-door with full piano-hinged front; secured with flush latch with tumbler lock; keyed alike.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.

2. Eaton.
 3. ABB.
 4. Siemens.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 - e. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - f. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - 1) Standard frame sizes, trip ratings, and number of poles.
 - 2) Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - 3) Application Listing: Appropriate for application; Type SWD for switching lighting loads. All circuit breakers shall be HACR rated.
 - 4) Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 5) Shunt Trip: 120 or 24 as required-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - 6) Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 7) Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - 8) Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - 9) Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - 10) Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.05 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.

- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Equipment Mounting: Install distribution panelboards on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with manufacturer's instructions to achieve seismic restraint of panelboard.
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. For flush-mounted panelboards, panelboards in finished spaces, or panelboards serving areas with raised floors: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: As required, engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Document and certify all testing performed.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as required.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Tamper-resistant receptacles.
 - 3. Weather-resistant receptacles.
 - 4. Snap switches, including motor-rated switches.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names:
 - 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Screw terminal guards.

2.04 GFCI RECEPTACLES

- A. General Description:
 1. Straight blade, feed-through type.
 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
 4. Screw terminal guards.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
- C. Weather-Resistant GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement se, and FS W-C-596. Provide for all receptacles located in damp or wet locations.

2.05 TAMPER-RESISTANT RECEPTACLES

- A. Tamper-Resistant, Duplex (125 V, 20 A)
 1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
 2. Line Voltage Receptacles: Two pole, three wire, and self-grounding, NEMA Configuration 5-20R.
 3. Standards: Comply with NEMA WD 1, UL 1310, and FS W-C-596.

2.06 SNAP SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Heavy-duty, quiet type, AC snap switch with green hex head grounding screw.
 1. Switches, 120/277 V, 20 A.

2. Motor rated switches: rated for 1 hp at 120VAC, 2hp at 240V-277V, with stainless steel cover plate and lockout guard/bracket.

2.07 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Satin-finished 302 stainless steel.
 3. Material for Unfinished Spaces: 302 stainless steel.
- B. Damp and Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weatherproof while-in-use, die-cast aluminum with lockable cover. Nonmetallic covers are not acceptable.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Red-Dot Codekeeper
 - b. Taymac
 - c. Cooper
 - d. Hubbell

2.07 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: 302 stainless steel.
- C. Final normal power device color and wall plate finish to be determined during submittal review.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.02 GFCI RECEPTACLES

- A. Do not feed-through from GFCI receptacles for protection of downstream receptacles unless specifically noted.

3.03 IDENTIFICATION

- A. Comply with Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use white self-adhesive machine-printed label on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections
- B. Tests for Convenience Receptacles:
 1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 26 27 26

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SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in control circuits and enclosed switches.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, and descriptions of individual components. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - c. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - d. Current-limitation curves for fuses with current-limiting characteristics.
 - e. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - f. Coordination charts and tables and related data.
 - g. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse
 - 4. Coordination charts and tables and related data.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

1.07 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.08 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Mersen - Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class RK1, time delay.

2. Other Branch Circuits: Class RK1, time delay.
3. Control Circuits: Class CC, fast acting.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

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SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonfusible switches.
 - 2. Enclosures.
- B. Related Requirements:
 - 1. Section 26 27 26 "Wiring Devices" for motor rated snap switches.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01782 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than ten working days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Square D; a brand of Schneider Electric.
 - 3. Siemens.
 - 4. ABB.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Hookstick Handle: Allows use of a hookstick to operate the handle.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- 3.5 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 2816

SECTION 26 51 00

LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Interior lighting fixtures.
 - 2. Exterior fixtures, mounted on or in close proximity to the building structure.
 - 3. Emergency lighting units.
 - 4. Exit signs.
 - 5. Lighting fixture supports.
- B. Related Sections:
 - 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including wall-box dimmers, occupancy sensors, time switches, contactors, and photocells.
 - 3. Section 26 27 26 "Wiring Devices" for manual switches.

1.03 DEFINITIONS

- A. BF: Ballast factor.
 - 1. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. LED: Light Emitting Diode

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Driver.
 - 4. Energy-efficiency data.
 - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for fixtures.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

- a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
 - b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Installation instructions.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- B. Product Certificates: For each type of ballast for dimmer-controlled fixtures, from manufacturer.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Fixture-mounted, emergency battery pack: One for every 20 emergency lighting unit.
 - 4. Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.
- E. Mockups: Where required by architect during construction, provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 COORDINATION

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

1.10 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
 - 2. Warranty Period for Emergency Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.02 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
 - c. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp and ballast/driver characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. CCT and CRI for all luminaires.
- G. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.03 LED DRIVERS

- A. LED drivers shall meet the following requirements:
 - 1. Drivers shall have a minimum efficiency of 85%.
 - 2. Starting Temperature: -40° F.
 - 3. Input Voltage: 120 to 480 ($\pm 10\%$) V.
 - 4. Power Supplies: Class I or II output.
 - 5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μ s, 10kA/8 x 20 μ s) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C. Units shall be serviceable in-place by owner.
 - 6. Power Factor (PF): = 0.90.
 - 7. Total Harmonic Distortion (THD): = 20%.
 - 8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.
 - 9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

2.04 LED SOURCES

- A. Operating temperature rating shall be between -40° F and 120° F.
- B. Correlated Color Temperature (CCT): as noted on Drawings.
- C. Color Rendering Index (CRI): greater than or equal to 65.
- D. The manufacturer shall have performed JEDEC (Joint Electron Devices Engineering Council) reliability tests on the LEDs as follows: High Temperature Operating Life (HTOL), Room Temperature Operating Life (RTOL), Low Temperature Operating Life (LTOL), Powered Temperature Cycle (PTMCL), Non-Operating Thermal Shock (TMSK), Mechanical Shock Variable Vibration Frequency, and Solder Heat Resistance (SHR).

EMERGENCY POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with driver. Comply with UL 924.
 - 1. Emergency Connection: Operate fixture continuously at minimum lumen output indicated on Drawings. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture driver.

2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- B. External Type: Self-contained, modular, battery-inverter unit, remote mounted from lighting fixture. Comply with UL 924.
1. Emergency Connection: Operate fixture continuously at minimum lumen output indicated on Drawings. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture driver.
 2. Nightlight Connection: Operate remote fixture continuously.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type.
 5. Housing: NEMA 250, Type 1 enclosure.
 6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.06 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.07

1.2 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.

2.06 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- H. Aircraft Cable Support: Cable, anchorages, and intermediate supports recommended by luminaire manufacturer.

2.07 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 2. Adjustable window slide for adjusting on-off set points.

2.08 TEMPORARY LIGHTING

- A. Provide temporary lighting for all trades. Temporary lighting shall consist of festoon Metal-Halide Lamps. Minimum average light level shall be 10 footcandles. The use of permanent luminaires for temporary lighting is not allowed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least two (2) independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have a minimum breaking strength safety factor of 3 times the weight of the fixture.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
 - 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.02 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.03 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.04 STARTUP SERVICE

- A. Burn-in all fixtures that require specific aging period to operate properly, prior to occupancy by Owner.

3.05 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 26 51 00

SECTION 27 00 00
COMMUNICATIONS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of General Requirements/Provisions shall be considered a part of this section and shall have the same force as if printed herein full. In addition, all information related to communications infrastructure that is documented in the architectural, structural, mechanical, and electrical drawings/documents shall be included as part of the Communications documents.
- B. The contractor is responsible for review of the proposed system with the owner and construction manager prior to submission of associated shop drawings.
 - 1. Owner: York County Library
 - 2. Contact Person: Mr. Troy Beckham, IT Manager
Phone: 803-981-5849
Email: troy.beckham@yclibrary.org

1.02 QUALITY ASSURANCE

- A. Specifications, Standards and Codes: All work shall be in accordance with the following:
 - 1. The 2020 edition of the National Electrical Code (NFPA 70)
 - 2. American National Standards Institute (ANSI)
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. Telecommunications Industries Association (TIA)
 - 5. Electronic Industries Association (EIA)
 - 6. Building Industry Consulting Service International, Inc. (BICSI)
 - 7. Institute of Electrical & Electronics Engineers (IEEE)
 - 8. Underwriters Laboratories (UL)
 - 9. American Standards Association (ASA)
 - 10. Federal Communications Commission (FCC)
 - 11. Occupational Safety and Health Administration (OSHA)
 - 12. American Society of Testing Material (ASTM)
 - 13. Americans with Disabilities Act (ADA)
 - 14. Local city and county ordinances governing electrical work
 - 15. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

- A. The work to be done under this section of the Specifications shall include furnishing labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
- B. All materials, obviously a part of the Communications Infrastructure and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing

and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

- A. The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
 - 1. Voice/Data, Security Camera, & Audio/Video Cabling Infrastructure
 - 2. Communications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards
 - 3. Grounding and Bonding

1.05 DEFINITIONS

- A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:
- B. Provide: As used herein shall mean “furnish, install and test (if applicable) complete.”
- C. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.06 DRAWINGS

- A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.
- C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.
- E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.
- F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Communications plans.

- H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.
- I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.
- J. Review all architectural drawings for modular furniture.
- K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall," "shall be," "as indicated on the Drawings," "In accordance with," "a," "the" and "all are intended" shall be supplied by inference.

1.07 SUBMITTALS

- A. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items. The following shall be submitted:
 - 1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.
 - 2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
 - 3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.
- B. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.
- C. The approval of material, equipment, systems and shop drawings is a general approval subject to the Drawings, Specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.

1.08 QUALITY ASSURANCE

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a Full-Service Communications contractor specializing in the design, fabrication and installation of integrated communications systems and power distribution systems.
- B. Communications Systems specified shall be installed under the direction of a qualified Contractor, no subcontracting is allowed. Qualification requirements shall include submittal by the Contractor to the Owner of the following:
 - 1. A completed AIA Document A305 Contractor's Qualifications Statement to be evaluated and approved by the Owner.
 - 2. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
 - 3. Shall certify that they are manufacturer-authorized for work to be performed.
- C. Contractor shall be BICSI-certified and must work under the direction of a RCDD.
- D. The Owner reserves the right to reject any and all applicants and to waive any irregularities in application responses. Applications which contain false or misleading statements, or which provide information or reference that are not valid, will be rejected.

1.010 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate communications work with that of other sections as required to ensure that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.011 SITE INVESTIGATION

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project.

1.012 PERMITS

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Product substitutions are not allowed unless noted as "Or Approved Equal". The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.
- B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.
- C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.

- D. Submit request for approval of substitute materials in writing to the Owner at least ten days prior to bid opening.

2.02 MATERIALS

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.
- E. Components of an assembled unit need not be products of the same manufacturer but must offer a certified end-to-end solution.
- F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF CONDITIONS

- A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.
- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the Architect/Engineer.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.

- C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- D. As determined by the Architect/Engineer, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Architect/Engineer shall be final.
- E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

- A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the Architect/Engineer determines that the Contractor has installed equipment not readily accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Architect/Engineer, at no additional cost to the Owner. "Readily accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

- A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.
- B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.
- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

- A. See specific Division 27 sections for testing parameters of sub-systems.
- B. The Contractor shall verify that requirements of this Specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
- C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.

- D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the “as-installed” operating environment during the “System Operation Test.” Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the “System Operation Test.”
- E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.
- F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Architect/Engineer.
- G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Communications Contractor Project Manager and submitted for approval.

END OF SECTION 27 00 00

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SECTION 27 11 00
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Ladder rack.
 - 5. Grounding.
- B. Related Sections:
 - 1. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for cabling associated with system panels and devices.

1.03 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- D. LAN: Local area network.
- E. RCDD: Registered Communications Distribution Designer.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Floor-mounted cabinets and cable pathways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.08 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.01 BACKBOARDS

- A. Backboards: Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

2.02 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
1. Chatsworth Products (CPI)
 2. AMP; a Tyco International Ltd. company.
 3. Ortronics, Inc.
 4. Panduit Corp.
- B. General Frame Requirements:
1. Distribution Frames: Freestanding modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat black finish.
 3. CPI 46353-703 or equal.
- D. Cable Management – Horizontal
1. The horizontal wire manager shall be compatible with 19-inch equipment racks, cabinets or wall mount brackets.
 2. The horizontal cable manager shall provide support for patch cords at the front of the panel.
 3. The horizontal cable manager shall be 2 rack-units in height when matched with a 2 rack-unit patch panel or switch.
 4. The horizontal cable manager shall be 1 rack-unit in height when matched with a 1 rack-unit patch panel or switch.
 5. CPI 35441-xxx or equal.
- E. Cable Management – Vertical
1. The vertical cable manager shall be double-sided.
 2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
 3. The vertical cable manager shall be a minimum width of 5".
 4. Vertical cable manager color shall be black.
 5. CPI 35521-703 or equal.

- E. Wall-Mounted Cabinets: Steel, sheet-metal body, rear panel, and door construction.
 - 1. Swing-out, three-part design for access to rear of equipment, grounding lug, and a power strip.
 - 2. Baked-polyester powder coat black finish.
 - 3. Extruded metal frame with tinted tempered glass panel.
 - 4. Aluminum equipment mounting rails.
 - 5. Height and depth as required to accommodate all required equipment plus minimum 4U spare.
 - 6. Low-decibel dual-fan and filter kit mounted on bottom right and left sides of cabinet.
 - 7. Vertical cabling sections, lashing brackets, horizontal wire management bars as required to support all cabling.
 - 8. CPI Cube-iT or equal.

2.03 LADDER RACKS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - 1. B-Line; Eaton, Electrical Sector.
 - 2. Chalfant Manufacturing Company.
 - 3. Chatsworth Products.
 - 4. Cope; Atkore International.
 - 5. MonoSystems, Inc.
 - 6. MP Husky USA.
- B. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
- C. Ladder rack size shall be as indicated on Drawings.
- D. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
- E. Ladder Rack System color shall be black.
- F. CPI 10250-712 or equal.

2.04 TIE WRAPS AND VELCRO STRAPS

- A. Tie Wraps and Velcro Straps
 - 1. Backbone cables shall be fastened to support structures with tie wraps/Velcro straps.
 - 2. Horizontal cables shall be fastened to support structures with Velcro straps.
 - 3. Tie Wrap color shall be black (or red in plenum spaces).
 - 4. Velcro Strap color shall be black (or red in plenum spaces).
- B. C-RINGS/D-Rings
 - 1. C-rings/D-rings shall be used on backboards to support cables, patch cords and cross-connect wire.
 - 2. C-rings/D-rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.

2.05 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, size and type indicated on drawings by Erico or equal by B-Line, Harger, or Chatsworth.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.06 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 EXECUTION

3.01 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems.

3.02 Comply with NECA 1.

3.03 Comply with BICSI TDMM for layout and installation of communications equipment rooms.

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar

with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground as indicated on drawings.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 11 00

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
1. Cable pathways (outside of the Communications Equipment Room)
 2. UTP cabling.
 3. A/V cabling.
 4. Telecommunications and A/V outlet/connectors.
 5. Cable connecting hardware, patch panels, and cross-connects.
 6. Cabling system identification products.
 7. Firestopping for communications.
 8. Cable testing.
- B. Related Sections:
1. Division 27 Section "Communications Equipment Room Fittings" for communication pathways, cabinets, and mounting frames.
 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for cabling associated with system panels and devices.
- C. The contractor is responsible for review of the proposed system with the owner prior to submission of associated shop drawings.

1.03 DEFINITIONS

- A. A/V: Audio/Visual.
- B. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- C. BICSI: Building Industry Consulting Service International.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. HDMI: High-Definition Multimedia Interface.

- H. IDC: Insulation displacement connector.
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- L. RCDD: Registered Communications Distribution Designer.
- M. UTP: Unshielded twisted pair.
- N. VGA: Video Graphics Array.

1.04 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
 - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. The maximum allowable horizontal cable length is 328 feet. The length consists of 295 feet maximum of permanent link, 16 feet maximum of patch cable to the workstation equipment, and 16 feet maximum in the horizontal cross-connect.
- C. The horizontal cabling system shall be Category 6 compliant, plenum rated, unshielded twisted pair type. The cabling system shall be an end-to-end solution and covered under the manufacturer's warranty.
- D. All communications outlets and cabling must be tested and certified in compliance with ANSI/IEEE 802.3 and EIA/TIA 568 Category 6 compliance specifications.

1.05 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.06 SUBMITTALS

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

- B. Shop Drawings:
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 3. Cabling administration drawings and printouts.
 4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 7. Single line riser drawing indicating all system components and vertical wiring necessary to connect components.
 8. Floor plans showing all rooms, stairways, corridors, and horizontal exits. Include all data outlet locations. Indicate all cable sizes and types, counts, and routing through the building.
- C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.
- E. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field-testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
 4. Contractor shall submit a copy of a valid low voltage license in the State of South Carolina.

- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.08 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.
 - 2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.
 - 3. Test each pair of UTP cable for open and short circuits.

1.010 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.011 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.012 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Connecting Blocks: One of each type.

2. Device Plates: Five of each type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The cabling system must be "end-to-end" and covered under the manufacturer's warranty as a complete system. Mixed manufacturers under different warranties are not acceptable.
- B. See individual sections below for applicable manufacturers.

2.02 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.
- C. Cable Hangers
 1. J-Hooks
 - a. J-hooks shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables. J-hook shall be cULus Listed.
 - b. J-hooks shall have flared edges to prevent damage while installing cables.
 - c. J-hooks sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 2. Adjustable Non-Continuous Cable Support Sling
 - a. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair balanced twisted pair cables; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable. Cable support sling shall be UL Listed.
 - b. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 - c. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/8 inches deep.

2.03 UTP CABLE

- 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. Belden CDT Inc.; Electronics Division.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. Genesis Cable Products; Honeywell International, Inc.
 5. Mohawk; a division of Belden CDT.
 6. Superior Essex Inc.
 7. West Penn Wire and Cable.
- B. Description: 100-ohm, Category 6, 4-pair UTP equal to Superior Essex DataGain Category 6+.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following:
 - a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 5. Jacket Color Code: Provide cable jacket color according to service indicated. Different service cables shall terminate on separate patch panels.
 - a. Data: Blue
 - b. WiFi Access Points: Yellow.
 - c. Security Cameras: White.

2.04 HDMI CABLE AND CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advanced Wire Group.
 2. Audioquest.
 3. Belden Inc.
 4. Blue Jeans Cable.
 5. Crestron.
 6. Extron.
 7. Lastar, Inc. / Rapid Run
 8. Monster Cable.
 9. West Penn Wire.
- B. Cable Characteristics: HDMI-ATC Certified, recommended by cable manufacturer specifically for commercial applications, complying with HDMI Specification Version 2.1, 4K 120p, 8K, scene-by-scene Dynamic HDR, eARC, 48 Gbps bandwidth.
- C. HDMI (Plenum Rated): NFPA 70, Type CL2P or CMP.
1. No. 24 AWG, silver-tinned copper conductors; gas-injected, foam-FEP insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black low-smoke PVC.

4. Gold-plated Type A connectors with locking latches.
 5. Suitable for indoor installations.
- D. HDMI Outlet Connectors: HDMI 2.0 compliant, female pass-through barrel connectors factory screw-mounted to brushed aluminum mounting plate suitable for mounting in device boxes, Legrand or equal. Provide outlet quantity and layout in each device per Drawings.

2.05 UTP CABLE HARDWARE

- 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. AMP
 2. Ortronics.
 3. Panduit Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- D. Patch Panel: Category 6 modular panels housing multiple-numbered Category 6 jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
 2. Provide separate patch panels for each service: Data, Security Cameras, WiFi.
 3. Provide 20% spare capacity.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
1. Category 6, 8-Position, 8-Contact (8P8C) Modular Jack
 2. The connector module shall exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
 3. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
 4. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
 5. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.
 6. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
 7. Icons shall be used if offered from the manufacturer.
 8. Jack/Icon colors shall be:
 - a. Data: Blue
 - b. WiFi Access Points: Yellow.
 - c. Security Cameras: White.

- F. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.06 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
 - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
 - 2. For use with snap-in jacks accommodating any combination of UTP work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
 - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.07 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.08 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
- C. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-A document, manufacturer's recommendations and best industry practices.
- D. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.
- E. All labels shall be clear with black text.
- F. All cables shall be labeled with machine generated, wrap around labels.
- G. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet; 12" from termination block/patch panel.
- H. Labeling scheme shall be alphanumeric.

2.09 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. All cable shall be plenum-rated.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Provide and use lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.02 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. MUTOA shall not be used as a cross-connect point.
 - 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
 - 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
 - 1. Comply with TIA/EIA-568-B.2.
 - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

- D. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
 - 1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating Between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating Between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating Between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 - 6. Separation between Communications Cables and Lighting Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground as indicated on drawings.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: Class 1.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with manufacturer's requirements for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 1 level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

- a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.07 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 27 15 00

SECTION 275116 - PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. IP-based amplifier.
 - 2. Loudspeakers.
 - 3. Volume attenuator stations.
 - 4. Conductors and cables.

1.3 DEFINITIONS

- A. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.
- B. VU: Volume unit.
- C. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Power, signal, and control wiring.
 - 1. Include plans, elevations, sections, and attachment details.
 - a. Include final locations of volume attenuator stations.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Wiring Diagrams: For power, signal, and control wiring
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data: For Installer.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For public address systems to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017700 "Closeout Procedures" and Section 017823 "Operation and Maintenance Data," include the following:
 - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 - b. Operating instructions laminated and mounted adjacent to operating console location.
 - c. Training plan.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.

1.8 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2. Viking.
 3. Algo.
 4. Valcom.
- B. Source Limitations: Obtain public address system from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

- A. System Functions:
1. Provide standalone IP-based system to allow paging throughout the facility from any network IP-phone.
 2. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
 3. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
 4. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 SYSTEM DESCRIPTION

- A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
- B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
- C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch housing complying with EIA/ECA-310-E.

2.4 STANDALONE IP POWER AMPLIFIER

- A. Network amplifier unit that integrates with any 3rd-party VoIP telephone system.
1. Power Output: 120 watts RMS per channel at 70V/8 ohms.
 2. Network connection: Category 5 or better 10/100 connectivity.
 3. Inputs: One dedicated balanced line input with both Phoenix plug and XLR connections.
 4. Frequency Response: +/- 0.25 dB at rated power from 20 to 20,000 Hz.
 5. Distortion: Less than 0.03%.
 6. Include GUI-based DSP controls:
 - a. 16-band graphic equalizer.
 - b. 7-band parametric equalizer.

- c. Signal present and clip monitor.
- d. Adjustable high-pass, low-pass, and bandpass filters.
- e. Noise gate.
- f. Compressor/Limiter.
- 7. Outputs: for 4-ohm, 8-ohm, 25V, and 70V distributed systems.
- 8. Rack-mountable with ½-rack width wall, rack, or shelf mountable 1RU packages with 19" rack mount kit.
- 9. Cooling: Convection air cooling.
 - a. Amplifiers that require fans for cooling are not acceptable.

2.5 LOUDSPEAKERS

- A. Drop-In Ceiling Cone-Type Loudspeakers:
 - 1. Size: 8-inch treated paper main cone, secondary high-frequency cone and minimum 10-oz. ceramic magnet.
 - 2. Minimum Axial Sensitivity: 94 dB at 1 m, with 1-W input.
 - 3. Frequency Response: Within plus or minus 3 dB from 95 to 20,000 Hz.
 - 4. Minimum Dispersion Angle: 100 degrees.
 - 5. Matching Transformer: 70V/25V full-power rated with taps of 4, 2, 1, 0.5, and 0.25 watts, selectable by rotary switch. Maximum insertion loss of 0.5 dB.
 - a. Speaker shall allow transformer to be bypassed for 8-ohm operation.
 - 6. Flush-Ceiling-Mounted Units:
 - a. Fully enclosed in industrial grade steel back box, acoustically dampened.
 - b. Metal ceiling grille with non-reflective white baked enamel finish.
 - c. Four seismic attachment points
 - d. Speaker assembly shall fit in 2'x 2' ceiling grid system. For 2'x 2' installation, a support rail shall not be required and no cuts in the ceiling shall be necessary.
 - 7. UL 1480 listed.

2.6 OUTLETS

- A. Volume Attenuator Station: Wall-plate-mounted autotransformer type with paging priority feature.
 - 1. Wattage Rating: 10 W unless otherwise indicated.
 - 2. Attenuation per Step: 3 dB, with positive off position.
 - 3. Insertion Loss: 0.4 dB maximum.
 - 4. Attenuation Bypass Relay: SPDT. Connected to operate and bypass attenuation when all-call, paging, program signal, or prerecorded message features are used. Relay returns to normal position at end of priority transmission.
 - 5. Label: "PA Volume."
 - 6. Include six (6) stations in bid, coordinate location with Owner prior to shop drawing submittal.

2.7 CONDUCTORS AND CABLES

- A. Jacketed, twisted pair and twisted multipair, untinned solid copper.

1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch thick.
2. Plenum Cable: Listed and labeled for plenum installation.

2.8 PATHWAYS

- A. Cable Hangers: Comply with Section 271500 "Communication Horizontal Cabling" for J-hook requirements.
- B. Conduit and Boxes: Comply with Section 260533 "Raceways and Boxes for Electrical Systems". Flexible metal conduit shall not be used.
 1. Outlet boxes shall be not less than 4 inches wide, 4 inches high, and 2-1/2 inches deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method:
 1. Install cables in pathways except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used.
 - a. Install plenum cable in environmental air spaces, including plenum ceilings.
 - b. Comply with requirements for pathways and boxes specified in 271500 "Communication Horizontal Cabling" and Section 260533 "Raceways and Boxes for Electrical Systems".
 - c. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for installation of conduits and wireways.
- B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.

B. General Cable Installation Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
3. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

- D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

- A. Coordinate layout and installation of system components and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- C. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.
- D. Equipment Cabinets and Racks:
1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.

2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
 3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.
- E. Wall-Mounted Outlets: Flush mounted.
- F. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.
- G. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.
- H. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings recommended by manufacturer.
- I. Connect wiring according to Section 271500 "Communications Horizontal Cabling" and Section 280513 "Conductors and Cables for Electronic Safety and Security."

3.5 GROUNDING

- A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
- B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
1. Schedule tests with at least seven days' advance notice of test performance.
 2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
 3. Operational Test: Perform tests that include originating program and page messages at phone stations and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
 4. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as recommended by manufacturer.
 - a. Minimum acceptance ratio is 50 dB.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamplifier channel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 3 percent total harmonics.
 6. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
 7. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.
- C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.
- D. Public address system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
1. Include a record of final speaker-line matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the public address system and equipment. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 275116

SECTION 28 05 13

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Low-voltage control cabling.
 - 2. Control-circuit conductors.
 - 3. Fire alarm wire and cable.
 - 4. Identification products.

1.03 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. EMI: Electromagnetic interference.
- C. IDC: Insulation displacement connector.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

1.04 ACTION SUBMITTALS

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

1.05 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.

1.08 FIELD CONDITIONS

- A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.
 - 1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory packing materials.
- B. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMP.
 - 1. One pair, twisted, No. 16 AWG, stranded tinned copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.

2.03 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.
- B. Class 2 Control Circuits: Stranded copper, power-limited cable, complying with UL 83, concealed in building finishes. Install in raceway where exposed.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.04 FIRE ALARM WIRE AND CABLE

- 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. Belden.
 - 2. Comtran Corporation.
 - 3. Draka Cableteq USA.
 - 4. Genesis Cable Products; Honeywell International, Inc.
 - 5. Rockbestos-Suprenant Cable Corp.
 - 6. West Penn Wire.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. All cable to be plenum rated.
- D. Signaling Line Circuits: Twisted, shielded pair, not less than size as recommended by system manufacturer.
- E. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

2.05 IDENTIFICATION PRODUCTS

- 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. Brady Worldwide, Inc.
 - 2. HellermannTyton North America.
 - 3. Kroy LLC.
 - 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.06 SOURCE QUALITY CONTROL

- A. Cable will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.02 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Install wiring in metal pathways and wireways, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. No cabling shall be routed exposed to view except in head-end equipment rooms; install exposed cabling in conduit.
 - 1. Minimum conduit size shall be 3/4 inch.
 - 2. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
 - 4. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 5. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Install cable, concealed in accessible ceilings, walls, and floors when possible.
- D. Where unenclosed wiring method is allowed above accessible ceiling spaces, use J-hooks. Cabling shall be neatly dressed by type in J-hooks along walls to outlet location.
- E. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- F. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

- G. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
 - H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.
- 3.03 POWER AND CONTROL-CIRCUIT CONDUCTORS
- A. 120-V Power Wiring: Provide 600V THHN/THWN in EMT.
 - B. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.
- 3.04 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies using an approved UL-listed method.
- 3.05 GROUNDING
- A. For low-voltage wiring and cabling, comply with requirements of the NEC.
- 3.06 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: As required, engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
 - B. Document data for each measurement. Print data for submittals in a summary report, or transfer the data from the instrument to the computer, save as text files, print, and submit.
 - C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - D. Prepare test and inspection reports.

END OF SECTION 28 05 13

SECTION 28 31 11
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Device guards.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Network communications.
- B. Related Requirements:
 - 1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.03 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.

- B. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 2. Include plans, elevations, sections, details, and attachments to other work.
 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 4. Detail assembly and support requirements.
 5. Include voltage drop calculations for notification-appliance circuits.
 6. Include battery-size calculations.
 7. Include input/output matrix.
 8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
 9. Include performance parameters and installation details for each detector.
 10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
 - a. Show field wiring required for HVAC unit shutdown on alarm.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
 - c. Locate detectors according to manufacturer's written recommendations.
 12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified, fire-alarm technician; Level II minimum.
 - c. Licensed or certified by authorities having jurisdiction.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.

3. Smoke Detectors, Heat Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician, minimum.
- C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

1.09 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.010 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- B. Automatic sensitivity control of certain smoke detectors.

- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 5. Record events in the system memory.
 - 6. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. User disabling of zones or individual devices.
 - 2. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4. Loss of primary power at fire-alarm control unit.
 - 5. Ground or a single break in internal circuits of fire-alarm control unit.
 - 6. Abnormal ac voltage at fire-alarm control unit.
 - 7. Break in standby battery circuitry.
 - 8. Failure of battery charging.
 - 9. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Supervisory Signal Actions:
 - 1. Initiate notification appliances.
 - 2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
 - 3. Record the event on system printer.
 - 4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.03 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Fire alarm control unit shall be Edwards EST3X or equal by Notifier, Fire-Lite, Silent Knight, Kidde, or Johnson Controls/Simplex.
- B. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and labeled by an NRTL.
 - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
 - d. The FACP shall be listed for connection to a central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
 - 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
 - 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1. Pathway Class Designations: NFPA 72, Class B.
 - 2. Install no more than 50 addressable devices on each signaling-line circuit.
 - 3. Serial Interfaces:
 - a. One dedicated RS 485 port for central-station operation using point ID DACT.
 - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - c. One USB or RS 232 port for PC configuration.
- E. Smoke-Alarm Verification:
 - 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.

2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Record events by the system printer.
 4. Sound general alarm if the alarm is verified.
 5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- F. Notification-Appliance Circuit:
1. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.
- G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.
- H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed lead calcium.
- M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.04 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.05 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c. Multiple levels of detection sensitivity for each sensor.
 - d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.

- e. Sensor range (normal, dirty, etc.).
- C. Ionization Smoke Detector:
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
 - 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - 6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.06 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
 - 1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 - 1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.07 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 - 1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 - 2. Mounting: Wall mounted unless otherwise indicated.
 - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - 4. Flashing shall be in a temporal pattern, synchronized with other units.
 - 5. Strobe Leads: Factory connected to screw terminals.
 - 6. Mounting Faceplate: Factory finished, red.
- C. Audible Notification Appliances:
 - 1. Description: Horns, bells, or other notification devices that cannot output voice messages.
 - 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.
 - b. General Characteristics:
 - 1) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 2) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
 - 3) ISO Temporal 3 Evacuation Tone: 90 plus or minus 4 dB(A-weighted) at 24 V.
 - 4) ISO Temporal 3 Alert Tone: 95 plus or minus 5 dB(A-weighted) at 24 V.
 - 5) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. (3 m) from horn, using coded signal prescribed in UL 464 test protocol.
 - 6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

2.08 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush or Surface cabinet, NEMA 250, Type 1. Coordinate exact type with mounting location approved by local fire marshal.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.09 ADDRESSABLE INTERFACE DEVICE

- A. General:
 - 1. Include address-setting means on the module.
 - 2. Store an internal identifying code for control panel use to identify the module type.
 - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown, to initiate operation of fire dampers, shutters, and similar items.
 - 1. Allow the control panel to switch the relay contacts on command.
 - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
 - 1. Operate notification devices.

2.010 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
- C. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - 1. Verification that both telephone lines are available.

2. Programming device.
 3. LED display.
 4. Manual test report function and manual transmission clear indication.
 5. Communications failure with the central station or fire-alarm control unit.
- D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
 2. Address of the supervisory signal.
 3. Address of the trouble-initiating device.
 4. Loss of ac supply.
 5. Loss of power.
 6. Low battery.
 7. Abnormal test signal.
 8. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.011 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by device manufacturer.
 2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
 - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing:
 - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet .
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to NFPA 72.
 - 5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
- E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
 - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
 - 2. Fire alarm contractor shall furnish detector, mechanical contractor shall mount detector, and fire alarm contractor shall wire detector.

- G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- H. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at locations complying with NFPA 72. Install all devices at the same height unless otherwise indicated.
- J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.03 PATHWAYS

- A. Pathways above ceilings and in nonaccessible locations may be routed exposed. Comply with Section 280513 "Conductors and Cables for Electronic Safety and Security", Section 260533 "Raceways and Boxes for Electrical Systems".

3.04 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.06 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.07 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.08 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication,

cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.09 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.010 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11