

DIVISION 1

GENERAL REQUIREMENTS

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SECTION 01010

SPECIAL PROVISIONS

PART 1 - GENERAL

1.01 INTENT OF CONTRACT

- A. The intent of the contract is to provide for the construction and completion of the work described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, specifications and terms of the contract.
- B. THE CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH THE LINES, GRADES, TYPICAL CROSS SECTIONS, DIMENSIONS AND OTHER DATA SHOWN ON THE PLANS OR AS MODIFIED BY WRITTEN ORDERS OF THE ENGINEER, AND ALL OTHER WORK DETERMINED BY THE ENGINEER AS NECESSARY TO PROPER EXECUTION AND COMPLETION OF THE PROJECT.

1.02 PLANS AND SPECIFICATIONS

- A. The plans, specifications and other Contract Documents will govern the work. The Contract Documents are intended to be complementary and cooperative and to describe and provide for a complete project.
- B. While it is believed that most of the information pertaining to conditions which may affect the cost of the proposed work will be shown on the plans or indicated in the specifications, the City does not warrant the completeness or accuracy of such information. It is the Contractor's responsibility to ascertain the existence of any conditions affecting the cost of the work which would have been disclosed by reasonable examination of the site.
- C. The Contractor shall, upon discovering any error or omission in the plans and specifications, immediately call it to the attention of the Engineer.

1.03 REFERENCE SPECIFICATIONS

- A. Codes and standards which establish qualities and types of workmanship and materials, and which establish methods for testing and reporting on the relative characteristics of materials are referenced throughout the Contract Documents.
- B. THE CONTRACT DOCUMENTS REQUIRE THAT MATERIALS AND WORKMANSHIP MEET OR EXCEED THE SPECIFICALLY NAMED CODE OR

STANDARD, AND IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PROVIDE MATERIALS AND WORKMANSHIP WHICH MEET OR EXCEED THE SPECIFICALLY NAMED CODE OR STANDARD.

- C. It shall also be the Contractor's responsibility to deliver to the Engineer proof that the materials or workmanship, or both, meet or exceed the requirements of the specifically named code or standard, when required by the Contract Documents or by written request from the Engineer. Submittals of the required proof shall be in the form requested in writing by the Engineer, and generally will be required to be copies of a certified report of tests conducted by an agency approved for that purpose by the Engineer.
- D. Whenever a specifically named code or standard is referenced in the Contract Documents, it shall be understood to mean the latest revision of said code or standard as amended prior to the date of Invitation for Bids.
- E. It shall be the Contractor's responsibility to verify the detailed requirements of the specifically named codes and standards and to verify that the items procured meet or exceed the specified requirements.
- F. The Engineer is required to reject any item used in this work which fails to meet the specified minimum requirements.

1.04 RESPONSIBILITY OF THE CONTRACTOR

- A. The Contractor shall do all the work and furnish all labor, materials, equipment, tools and machines necessary for the performance and completion of the project in accordance with the contract documents within the specified time.
- B. Structures built by the Contractor but not a part of the permanent project shall meet the approval of the Engineer, but such approval shall not relieve the Contractor from responsibility for their safety and sufficiency.
- C. The Contractor shall be responsible for all expense involved in making any required changes in the plans or specifications to accommodate a substitution approved by the Engineer for the convenience of the Contractor or to circumvent an unforeseen difficulty in obtaining a specified article.
- D. THE CONTRACTOR SHALL ASSUME ALL RESPONSIBILITY FOR THE WORK. As between the Contractor and the City, the Contractor shall bear all losses and damages directly or indirectly resulting to him, to the City, or to others because of the performance of the work, unforeseen difficulties, accidents or any other cause whatsoever. The Contractor shall assume the defense and indemnify and save harmless the City, its officers, and employees from all claims, liability, loss,

damage and injury of every kind, nature and description, directly or indirectly resulting from the Contractor's activities in the performance of the contract, the ownership, maintenance or use of motor vehicles in connection therewith, or the acts, omissions, operations, or conduct of the Contractor or any subcontractor under the contract, or in any way arising out of the contract, irrespective of whether fault is the basis of the liability of claim, and irrespective of whether any act, omission or conduct of the City connected with the contract is a condition of contributory cause of the claimed liability, loss, damage or injury and irrespective of whether act, omission or conduct of the Contractor or subcontractor is merely a condition rather than a cause of the claim, liability, loss, damage or injury. The Contractor shall not be liable for, nor be required to defend or indemnify the City relative to claims for damage or damages resulting solely from acts or omissions of the City, its officers, agents or employees.

1.05 PROSECUTION AND PROGRESS OF WORK

A. Preconstruction Conference

1. A preconstruction conference will be scheduled by the City prior to the commencement of any work. The meeting is to include, but not necessarily be limited to, representatives of the following groups: City, Contractor, and permitting officials.
2. The purpose of the conference will be to discuss the construction schedule, procedures for handling shop drawings, requests for information, partial payment applications, and items of the work which require special coordination.

B. Notice to Proceed

1. Written notice to proceed will be given after the contract has been executed and the performance bond and all required insurances have been filed with and approved by the City.
2. THE CONTRACTOR SHALL NOTIFY THE ENGINEER OF THE TIME AND LOCATION THAT WORK WILL BEGIN AT LEAST 48 HOURS PRIOR TO BEGINNING WORK.

C. Contract Time

1. The Contract time will begin with the date specified in the Notice to Proceed.
2. The contract time shall be in terms of calendar days.

D. Night and Weekend Work

1. Unless otherwise especially permitted, no work shall be done between the hours of 4:00 p.m. and 7:00 a.m., nor on Saturday, Sunday, or City holiday except as necessary for the proper care and protection of work already performed. If it shall become absolutely necessary to perform work at night, on the weekend or City holiday, the City shall be informed at least forty-eight (48) hours in advance of the beginning of performance of such work and the City must grant approval.

E. Construction Sequencing and Coordination

1. The Contractor shall, prior to beginning any work, prepare and submit for review a sequence of construction that includes all of the work included in the Contract. All work under this contract shall be completed within the construction time stated in these specifications.
2. The sequence of construction shall show items of work on the critical path and other major items that have the potential to lie on the critical path.
3. The Contractor is responsible for the proper coordination of the work including that work performed by subcontractors, to prevent interference with the operation of the various facilities and to assure that the City is made aware in advance of proposed construction activities. The Contractor shall provide the City and Engineer with 5 calendar days minimum notice prior to each service interruption unless otherwise approved by the City.
4. There will be no basis for claim for extra compensation or contract time extension due to delay caused by the Contractor's failure to give proper notice for requested shutdowns or to advise the City of proposed construction activities that in the judgment of the City will interfere with operation of the various facilities.
5. To keep service interruptions and accessibility restrictions to an absolute minimum time, the Contractor shall be required to (1) do all preparatory work possible prior to the specified equipment being taken out of service, (2) have adequate personnel and equipment to work simultaneously, if required, at more than one location of shutdown work, and (3) to work continuously more than the regularly scheduled working day if directed by the Engineer.
6. The Contractor shall be responsible for determining and coordinating the location, size and arrangement of all chases and openings and shall establish clearances in concealed spaces required for the proper installation of the work and shall see that such are provided.

F. Suspension of Work

1. The City may, on its own volition and in the public interest, temporarily suspend the Contractor's operations on the project or upon any part of it. In the event of such suspension, except in emergency, the Contractor shall be given three (3) calendar days notice and the work shall be resumed within five (5) calendar days after notice has been given to the Contractor to do so. The City shall allow the Contractor an extension of time for completion corresponding to the total period of the temporary suspension and shall reimburse the Contractor for necessary rental of unused equipment, services of watchmen, and other unavoidable expenses occurring by reason of the suspension without fault of Contractor. The Contractor shall not be entitled to damages, overhead costs, or anticipated profits arising from such temporary suspension.
2. The City shall have authority to suspend the work in whole or in part for failure of the Contractor to properly carry out the provisions of the contract or the directives of the City for such periods as the City may deem necessary due to conditions considered unsuitable for the performance of the work or for any reason deemed to be in the public interest.
3. If the Contractor voluntarily suspends operations for its own purpose, an order to resume the work may not be required or issued. However, in all cases of suspension of construction operations by the Engineer, the work shall not again be resumed until permitted by order of the Engineer. No additional time for completion or request for compensation will be allowed for voluntary suspensions of the work.
4. At the commencement of and during any suspension of the work, the Contractor shall be responsible for the care of the work performed and take every precaution to prevent any damage or deterioration of the work including temporary protection devices to warn, safeguard, protect, guide and inform traffic, during suspension the same as though its performance had been continuous and without interferences.
5. If the suspension of the work is due to failure on the part of the Contractor to correct conditions unsafe for workers or the general public, or to carry out orders given, or to perform any provisions of the contract, then and in such event, he shall be solely responsible for bearing the costs of maintaining the work under the contract during the period of suspension. If the Contractor at any time fails to maintain the work, the City may immediately proceed to maintain such work and the entire costs of this maintenance will be deducted from monies due or to become due the Contractor on the contract.
6. The Contractor's voluntary or involuntary suspension or slowdown, with or without the approval of the Engineer, and suspension of the work ordered by the Engineer or the City will not be grounds for claims by the Contractor for

damages, idle equipment or labor or extra compensation.

7. The Contractor shall be responsible for damage to the work that may occur during suspension of work the same as though the damage had occurred while the work was in progress.

G. Delays and Extensions

1. The City may grant extensions of time to the extent it finds reasonable and justified when the delay is due solely to causes beyond the control of the Contractor and subcontractors and without any fault or negligence or participation by them.

H. Completion of Work by City

1. If the work to be done under this contract should be abandoned by the Contractor, or if this contract shall be assigned, or the work sublet by him, otherwise than as herein specified, or if at any time the Engineer shall be of the opinion that the performance of the contract is unnecessarily or unreasonably delayed or that the Contractor is willfully or continuously violating any of the conditions or covenants of this contract, or of the Specifications, or is executing the same in bad faith or not in accordance with the terms thereof; or if the work be not fully completed within the time named in this contract for its completion, or within the time to which the completion of the contract may be extended by the City, the City may notify the Contractor to discontinue all work, or any part thereof under this contract, by a written notice to be served upon the Contractor, as herein provided; and the Contractor shall, within five (5) calendar days of the service of said notice, discontinue the work, or such part thereof, and the City shall thereupon have the power to contract for the completion of the Contract in the manner prescribed by law, or to place such and as many persons as it may deem advisable, by contract or otherwise, to work, and complete the work herein described, or such part thereof; to procure materials and equipment for the completion of the same, and to charge the expense of said labor and materials to the Contractor. The expense so charged shall be deducted and paid by the City out of such monies as may be due or may at any time thereafter become due to the Contractor under and by virtue of this contract, or any part thereof. And in case such expense shall exceed the amount which would have been payable under the Contract if the same had been completed by the Contractor, the Contractor and his surety shall pay the amount of such excess to the City.

I. Termination of Contract

1. All terms and conditions of the contract are considered material, and failure by the Contractor to comply with any of said terms or conditions shall, at the City's option, be deemed a breach of the contract. Upon such failure, the City shall have the right, whether an alternative right is provided or not, to declare the contract terminated. The issuance by the City of an order stating that the contract is terminated, and service of a copy of said order upon the Contractor and the Contractor's surety shall be deemed a complete termination of the contract. Upon the contract being so terminated, the City may retain all sums due under the contract and both the Contractor and his sureties shall be liable under the bond for all losses, expenses and damages caused to the City by reason of failure to complete the contract, and the surety shall be required, at the City's option, to complete the project. Notwithstanding such termination, the Contractor and the Contractor's sureties shall remain liable under the terms of the contract for work performed prior to such termination.

J. Default by Contractor

1. If the Contractor fails to begin work as required by the contract, or be adjudged bankrupt, or make a general assignment for the benefit of his creditors, or a receiver is appointed on account of insolvency, or if at any time when work has been resumed after a Suspension of Work, the Contractor refuses, neglects or fails to correct the deficiency(s) or reason(s) for the suspension, or if the Contractor abandons the work, the Engineer may give written notice of default to the Contractor and the Contractor's surety, and the Contractor shall discontinue or not begin the work, and any or all payments due or that may become due the Contractor may be withheld by the City until the completion by the City, surety, or another person of all work included in the contract, and until expiration of any maintenance and/or warranty period.
2. After service on the Contractor of such order to desist from work or part thereof, or notice of termination, the City may take possession of the project or such designated part thereof, and may, by contract or otherwise, provide supervision of workers, materials, appliances and equipment necessary for the completion of, and complete the project or such designated part thereof. The expense incurred for completion of the project or part thereof, together with all damages, liquidated or otherwise sustained or to be sustained by the City shall be deducted from the fund or appropriation set aside for the purpose of the contract and shall be charged to the Contractor as if paid. In case the amount of such expenses and damages exceeds the sum which would have been payable under the contract if completed entirely by the Contractor, the amount of such excess shall be paid to the City by the Contractor and the Contractor's sureties shall be liable to the City therefore; in case the amount of such expenses and damages shall be less than the sum which would have been payable under the contract if completed entirely by

the Contractor, he shall be entitled only to payment in accordance with contract terms for the work the Contractor actually performed, subject however, to all terms of said contract.

3. The Contractor shall complete all work unless an order to desist as provided above has been received, and shall cooperate with and in no way hinder or interfere with forces employed by the City or others.
4. None of the foregoing provisions shall be construed to require the City to complete the work, or to waive or in any way limit or modify the provisions of the contract relating to the fixed and liquidated damages suffered by the City on account of the failure of the Contractor to complete the project within the time prescribed.

K. Operation or Use of Facilities Prior to Completion

1. Work under this Contract shall be executed so that the facilities may be used as soon as possible. It is understood that the City may use any completed facility.
2. Use, by the City, of any facility prior to the Engineer's final certificate for all work under the Contract will not be considered as constituting acceptance nor will the period of time the facility is used be considered as part of the required one-year guarantee period.

L. Use of Existing Facilities

1. The Contractor shall not hinder the City in the use of the existing facilities. Any work by the Contractor limiting the use of the existing facilities by the City shall be conducted at a time acceptable to the City.

M. Changes in Work

1. Changes requested by the Contractor: Changes in specified methods of construction may be made at the Contractor's request when approved in writing by the Engineer.

Changes in the plans and specifications, requested in writing by the Contractor, which do not materially affect the work and which are not detrimental to the work or to the interests of the City, may be granted by the Engineer. No additional payment will be made for these changes.

2. Changes initiated by the City: The City may change the plans, specifications, character of the work, or quantity of work both additive and deductive. This contract amount may not be increased by more than twenty-five percent (25%) of the original contract amount.

Change orders shall be in writing and state the dollar value of the change or establish method of payment, any adjustments in contract time and, when negotiated prices are involved, shall provide for the Contractor's signature indicating acceptance.

Payment for all work will be made per these Special Provisions.

N. Changed Conditions

1. Should the Contractor encounter subsurface or latent physical conditions at the site differing materially from those indicated in the contract or unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, which changed or unusual conditions will be considered by the Contractor as the basis for a claim for extra compensation, the Contractor shall promptly notify the Engineer of the alleged conditions in writing. Changed conditions that occur as a result of any negligence or inattention on the part of the Contractor or his agent shall not be considered eligible for extra payment.

IF THE ENGINEER IS NOT GIVEN WRITTEN NOTICE WITHIN SEVEN (7) CALENDAR DAYS OF THE DATE OF FIRST DISCOVERY, THE CONTRACTOR WILL BE DEEMED TO HAVE WAIVED ANY CLAIM OR CLAIMS FOR EXTRA COMPENSATION IN ANY MANNER ARISING OUT OF THE CHANGED OR UNUSUAL CONDITIONS.

If the City shall determine the conditions to be such as to justify a claim for additional compensation, it may provide for additional payment as specified in Section 1.05.M for the particular phase of work in question, or by any other equitable arrangement mutually agreed upon by the City and Contractor. In any event, the Contractor shall not be relieved, unless permitted to do so by the City, from his obligation of resuming construction operations pending decision as to the validity of a claim, or pending the execution of a negotiated agreement to cover additional costs if a claim shall be recognized under the provisions of this section of the specifications.

O. Claims for Unauthorized Extra Work

1. If the Contractor performs work which he considers is not included under any of the items of the contract and which has not been specifically ordered in writing by the City as extra work, he may make a claim for extra payment for such work by immediate oral notice followed by written notice within ten (10) calendar days after the occurrence to the City, with detailed cost data to support his claim within thirty (30) calendar days after the said work is performed.

Should such work extend over a period of more than thirty (30) calendar days, he shall submit monthly records of all cost data relating to the claim for extra payment of such work.

P. Disputed Work

1. If unable to reach agreement under any of the foregoing procedures, the City may direct the Contractor to proceed with the work. Payment shall be as determined by Section 1.05.R.

Although not to be construed as proceeding under extra work provisions, the Contractor shall keep and furnish records of all disputed work.

Q. Extra Work

1. Any extra work made necessary by alteration of, or additions to the plans, or by other reasons for which no price is provided in the contract, shall be performed by the Contractor as directed by the Engineer and he shall be compensated therefore as elsewhere provided herein.

Minor changes in the work not involving extra cost and not inconsistent with the purpose of the work may be made by verbal order, but no modifications involving extra work shall be made unless ordered in writing by the City.

R. Payment for Extra Work

1. The Contractor agrees that he will accept as full compensation for extra work, the unit prices bid, where such are applicable; and for such items as are not properly covered by unit prices, a lump sum agreed upon as reasonable by the City and the Contractor. When a schedule of values has been provided by the Contractor on a lump sum contract, the values may, at the discretion of the City, be used as a basis of payment. If an agreement cannot be made for payment for extra work on a unit price or lump sum basis, the Contractor will accept as full compensation the reasonable cost, as determined by the City, of all necessary labor, including insurance and payroll taxes, equipment rental and materials, plus fifteen percent (15%) which covers superintendence, the use of tools and plant, bonds, and other

overhead expenses and profit. For all such work done by Subcontractors, each Subcontractor may add fifteen percent (15%) of his actual net increase in costs for combined overhead and profit, and the Contractor may add up to five percent (5%) of the Subcontractor's total for his combined overhead and profit; provided that no overhead and profit shall be allowed on costs incurred in connection with premiums for public liability insurance or other special insurance directly related to such Work.

Equipment rental charges shall be the pro-rated charge actually paid by the Contractor in the case where equipment is rented, except that this rental charge shall not exceed the latest rates published in the Rental Rate Blue Book by National Research and Appraisal Company. If the equipment is owned by the contractor, the equipment rental charge shall be pro-rated on the basis of the monthly rates published in the Rental Rate Blue Book. All fuel and lubrication costs will be paid for separately on a reimbursable basis.

The Contractor agrees to execute and complete such extra work with all reasonable diligence, and to employ thereon competent men. The Contractor shall give the City access to all accounts, bills, payrolls and vouchers relating to extra work not covered by unit prices, and he agrees that he shall have no claim for compensation for such extra work in the case of items not covered by unit prices unless a statement in writing of the actual cost of the same, fully itemized as to labor and materials, is presented to the City before the thirtieth (30th) day of the month following that during which each specific order was complied with by him.

S. Final Inspection

1. At such time as all construction work on the project is complete and all bills, forms and documents required under the contract are submitted, the Contractor shall so notify the Engineer in writing. The Engineer will make an inspection of the project and the project records within fifteen (15) calendar days of receiving said notice. If as a result of such inspection, all construction provided for and ordered under the contract is found completed and satisfactory, and all certifications, bills, forms and documents have been properly submitted, such inspection shall constitute the final inspection.
2. If any work in whole or in part is found unsatisfactory, or it is found that all certifications, bills, forms, and documents have not been properly submitted, the Engineer shall give the Contractor the necessary instructions regarding the replacement of material and the performance or re-performance of construction work necessary and prerequisite to satisfactory final completion of construction work and shall give the Contractor the necessary instructions for submission of bills, forms and documents. The Contractor forthwith shall comply with and execute such instructions. At such time as such instructions are complied with

and executed, the Contractor shall so notify the Engineer in writing. The Engineer will make another inspection within fifteen (15) calendar days after such notice and this inspection shall constitute the final inspection, if all requirements have been met to the satisfaction of the Engineer. If the instructions are not completed to the satisfaction of the Engineer, additional instructions will be issued by the Engineer and the process will be repeated until the Engineer is satisfied that all requirements have been complied with.

T. Completion and Acceptance

1. After completion of all items of work specified in the contract, and completion of the final inspection as set forth above, the Engineer will recommend to the City that the work be accepted and payment be made as provided for in paragraph 1.06.
2. IT IS MUTUALLY AGREED BETWEEN THE CITY AND THE CONTRACTOR THAT NO PAYMENT MADE UNDER THE CONTRACT EXCEPT THE FINAL PAYMENT SHALL BE EVIDENCE OF THE PERFORMANCE OF THE CONTRACT, EITHER WHOLLY OR IN PART, AND THAT NO PAYMENT SHALL CONSTITUTE AN ACCEPTANCE OF UNAUTHORIZED OR DEFECTIVE WORK OR IMPROPER MATERIAL.
3. The acceptance of the contract work shall not prevent the City from making claim against the Contractor for any defective work if same is discovered within the guaranty period.
4. During the final inspection minor deficiencies may be noted which do not substantially affect the intent of the Contract Documents. These items will be noted and supplied to the Contractor before final payment. Until such time as these items are corrected final payment may be withheld.

1.06 MEASUREMENT AND PAYMENT

- A. A Schedule of Values shall be prepared by the Contractor and submitted for review and approval to the Engineer within 10 days of the execution of the contract and shall serve as a breakdown of the lump sum bid for the purpose of arriving at a basis for the monthly estimate. The schedule shall be broken down into categories according to specification sections. The Contractor shall revise the Schedule of Values as necessary to obtain approval. The Schedule shall represent a fair and reasonable allocation for each item and shall add up to 100% of the Lump Sum bid.

- B. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place, ready for service and accepted by the City.
- C. Payments during the course of the work for lump sum items will be made on the basis of percentage completion of the work items listed in the Schedule of Values for each lump sum item.
- D. The acceptance by the Contractor of the final payment shall release the City and its representatives from all claims and all liability to the Contractor for all things done or furnished in connection with the work, and every act of the City and others relating to or arising out of the work. No payment, however, final or otherwise, shall operate to release the Contractor or the contractor's sureties from obligations under the contract and the performance, payment and other bonds and warranties, as herein provided.

1.07 FINAL GUARANTY

- A. All work shall be and is guaranteed by the Contractor for a period of one (1) year after the date of final acceptance of all the work by the City.
- B. If, within said guaranty period, repairs or changes are required in connection with guaranteed work, which, in the opinion of the Engineer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract, the Contractor shall, promptly upon receipt of notice from the City, and without expense to the City: a) place in satisfactory condition in every way all such guaranteed work, correct all defects therein; and b) make good all damage to the building site, equipment, or contents thereof which in the opinion of the Engineer, is the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and c) make good any work or material, or the equipment and contents of the building, structure or site disturbed in fulfilling any such guaranty.
- C. If the Contractor, after notice, fails within ten (10) days to proceed to comply with the terms of this guaranty, the City may have the defects corrected, and the Contractor and his surety shall be liable for all expense incurred provided however, that in case, of an emergency where, in the opinion of the Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to the Contractor and the Contractor shall pay the cost thereof.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall submit to the Engineer for review and approval such shop drawings, test reports and product data on materials and equipment (hereinafter in this article called data), and material samples (hereinafter in this article called samples) as are required for the proper control of work, including but not limited to those shop drawings product data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.

1.02 TYPES OF SUBMITTALS

- A. Shop drawings for manufactured or fabricated items, pipe layout or other schedules, diagrams and like material prepared specially for this project.
- B. Product Data which include pre-printed material, manufacturer's descriptive literature, illustrations, catalog data, performance charts and the like intended to identify a part of the work but not necessarily prepared exclusively for this Contract.
- C. Samples which include physical examples of products, materials, assemblies or workmanship which are identical to a portion of the work and which establish standards for materials, workmanship, or appearance of the finished work.
- D. Administrative data to include information required to support the administrative requirements of the contract as called for in the specifications.

1.03 SUBSTITUTIONS

- A. Alternate equipment and/or materials must be submitted to the Engineer within ten (10) calendar days after the Award of Contract. Failure to submit information on alternate equipment and/or materials may be cause for rejection of the proposed alternate and only the specified equipment and/or materials will be permitted to be incorporated in the finished project.
- B. All alternate equipment and/or materials offered must comply with the detailed requirements of the Drawings and Specifications and shall be covered by the specified guarantees and warranties. If it is determined that the alternate equipment and/or materials do not conform to the Specifications, the Contractor will be required to furnish and install other equipment and/or materials to meet the Specifications.

- C. The decision of the Engineer regarding evaluation of alternates shall be considered final and binding. Requests for time extensions and additional compensation based on submission of, acceptance of, or rejection of alternates will not be allowed.
- D. Specified equipment and materials have been used to prepare the Drawings. Changes in piping, wiring, structure, etc., necessary to accommodate alternates shall be submitted by the Contractor to the Engineer for approval and/or revision.
- E. The Contractor shall pay for all additional installation costs necessitated by the selection of alternate equipment and material. Such costs are included in the Contract bid price and any modifications as stated in the Bid.

1.04 PROCEDURE FOR SUBMITTALS

- A. Except where specifically stated otherwise all submittals shall be made to the Engineer for his approval. Submittals shall be made in at least five copies. Two copies of the submittal will be retained by the City/Engineer and the other copies returned to the Contractor. Submittals shall be complete for each component of work or system and shall include all inter-related portions of a system.

1.05 CONTRACTOR'S RESPONSIBILITY

- A. It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the Engineer for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the Contract Documents.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with Specifications.
- C. The Contractor shall ensure that no work is begun on any item of work requiring an approved submittal until such approval is obtained.
- D. Each submittal shall be assigned a sequential number by the Contractor, for purposes of easy identification, and shall retain its assigned number with appropriate subscript, on required resubmissions. The assigned number shall consist of the specification section number where the item is specified, followed by a sequential number indicating the number of submittals in that Section (e.g., 03300-11 is the 11th separate submittal for items specified in Section 03300). Resubmittals shall be

identified with the same number as the original submittal, followed by the subscript R1, R2, etc. All products and materials submitted shall be clearly identified with the appropriate equipment name and number as it appears in the Contract Document.

- E. All submittals shall be made far enough in advance of scheduled dates for installation to provide all the time required for reviews, for securing the necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery. The Contractor shall submit to the Engineer all drawings and schedules to allow for no less than 14 calendar days for reviewing and appropriate action from the time the Engineer receives them. Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the contract completion date.
- F. All submittals shall be accompanied with a transmittal letter prepared in duplicate containing the following information:
 - 1. Date.
 - 2. Project Title and Number.
 - 3. Contractor's name and address.
 - 4. The Number of each Shop Drawing, Project Data, and Sample submitted.
 - 5. Notification of Deviations from Contract Documents.
 - 6. Submittal Log Number conforming to Specification Section Numbers.
- G. The Contractor shall be responsible for and bear all costs of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by Engineer of the necessary Shop Drawings.
- H. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposed to supply both as pertains to his work and any work affected under other parts, heading, or divisions of drawings and specifications at no cost to the City.

1.06 ENGINEER'S REVIEW OF SHOP DRAWINGS

- A. The Engineer's review of drawings, data and samples submitted by the Contractor will be only for conformance with the design concept of the Project and for general compliance with the information given in the Contract Documents. The Engineer's review and approval will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown. Review by the Engineer shall not be construed as a complete check, but only that the general method of construction and detailing is satisfactory. This review shall not relieve the Contractor of his responsibility for errors which may exist.

Approval of Shop Drawings shall not relieve the Contractor from the responsibility of furnishing materials and equipment of proper dimension, size, quality, quantity, and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Approval shall not relieve the Contractor from

responsibility for errors of any sort of the Shop Drawings. The Contractor is responsible for dimensions which shall be confirmed and correlated at the Project site. The Contractor is also responsible for information that pertains solely to the fabrication processes or to the technique of construction and for the coordination of the work of all trades, and for performing his work in a safe and satisfactory manner.

- B. The review of drawings and schedules will be general, and shall not be construed:
 - 1. as permitting any departure from the Contract requirements;
 - 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 - 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
 - 4. as approving Contractor's means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto.

- C. If the drawings or schedules as submitted describe variations and show departure from the Contract requirements which the Engineer finds to be in the interest of the City and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting any exception.

- D. When reviewed by the Engineer, each of the Shop Drawings will be identified as having received such review being so stamped and dated. Submittals stamped "Approved" or "Approved As Noted," with the Engineer's signature and dated, authorizes the Contractor to proceed with fabrication, purchase, or both, of the items so noted, subject to the changes, if any, required by the Engineer's review comments.

For submittals stamped "Revise and Resubmit," the Contractor shall make the revisions required by the Engineer. Each drawing revision shall be shown by number, date, and subject in the revision block on the drawing. Only those revisions directed or approved by the Engineer shall be made. After correction, the submittal shall be re-submitted to the Engineer and the process repeated until "Approved" or "Approved As Noted" is achieved.

Submittals stamped "Not Approved" shall not be revised or corrected by the Contractor; a new submittal on materials in conformance with the specifications shall be prepared and submitted.

- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by the Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.

If more than one resubmission is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse City for the charges of Engineer for review of the additional resubmissions. This does not include initial submittal data and/or shop tests and field tests which are submitted after the initial submittal.

Any need for more than one resubmission, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of Contract time unless delay of the Work is directly caused by a change of Work authorized by a Change Order or by failure of Engineer to review the submittal within the submittal review period specified herein and to return the submittal to Contractor.

- F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.
- G. Shop drawings and submittal data shall be reviewed by the ENGINEER for each original submittal and first resubmittal; thereafter review time for subsequent resubmittals will be charged to the CONTRACTOR at the rate of \$100 per hour.
- H. When the Shop Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items for:
 - 1. Systems
 - 2. Processes
 - 3. As indicated in specific specifications sections.

1.07 OPERATION AND MAINTENANCE MANUALS FOR EQUIPMENT AND PRODUCTS

- A. General:
 - 1. The Contractor shall furnish Operation and Maintenance Manuals for all products and equipment provided under this Contract.
 - 2. Prior to start-up and testing of any equipment, the Contractor shall furnish for the Engineer's review two copies of the final Operation and Maintenance Manual. The final manuals must be approved by the Engineer before a final inspection of the work will be conducted and prior to the issuance of the Certificate of Substantial Completion. Final manuals shall also be provided electronically on CD in searchable Adobe Acrobat Portable Document

Format. The electronic versions shall match the printed version in every aspect.

B. Manual Preparation:

1. Manuals shall include operation and maintenance information on all systems and items of equipment. The data shall consist of: catalogs, brochures, bulletins, charts, schedules, approved Shop Drawings corrected to as-built conditions and assembly drawings describing location, operation, maintenance, lubrication, operating weight, and other information necessary for the City to establish an effective operating maintenance program.

C. Approval:

1. Subsequent to the Engineer's approval and return of the final manual, the Contractor shall submit two complete sets of manuals (plus pdf format files) to the Engineer.
2. Final Completion certification will positively not be undertaken until approved Operation and Maintenance Manuals have been submitted. Partial approvals of the final manual will not be made.
3. Delivery of manufacturer's service (O&M) manuals and installation instructions satisfactory to the Engineer is an essential part of the equipment delivery. Incomplete or inadequate manuals will be returned to the Contractor for correction and/or resubmission.

1.09 MIX DESIGNS

Mix designs shall be submitted for concrete, grout, and mortar. Mix design shall indicate all materials used in the product and their respective relative quantities. In any one mix design all quantities shall be expressed either by weight or volume insofar as it is practical to do so.

1.10 DESIGN CALCULATIONS

Design calculations shall be presented in a neat, legible manner and shall bear the stamp and signature of a registered professional engineer, registered in the State of Virginia.

1.11 MILL TEST REPORTS

Mill test reports shall be submitted for structural steel and concrete reinforcement steel. Reports shall be on the mill's standard report form.

1.12 RECORD DRAWINGS

The Contractor will keep one copy of all Specifications, Drawings, Addenda, Change Orders and Shop Drawings in the field office at the site, in good order and annotated to show all changes made during the construction process. These shall be available to the Engineer and shall be delivered to him upon completion of the project. If the Contractor fails to maintain the record drawings as required herein, final payment with respect to the Contract as a whole, will be withheld until proper record drawings have been furnished to the Engineer.

END OF SECTION

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SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.01 CODES, RULES, PERMITS AND FEES

A. General:

1. The Contractor shall comply with the applicable Building Codes as well as the requirements of all permits required for the Work.
2. The Contractor shall give all necessary notices, obtain all permits (except as otherwise noted herein) and pay all governmental taxes, fees, and other costs in connection with the work, file all necessary plans, prepare all documents and obtain all necessary approvals of all government departments having jurisdiction, obtain all required Certificates of Inspection and Approval for the work and deliver same to the Engineer, except as otherwise noted herein.

B. Included Items:

1. The Contractor shall include in his work, all labor, materials, services, apparatus, and drawings required to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings or specified.

C. Compliance:

1. All materials furnished and all work installed shall comply with the rules, regulations and requirements of local utility companies, and with the requirements of all governmental departments having jurisdiction.

1.02 MATERIALS AND WORKMANSHIP

- A. All materials and equipment required for the work shall be new, unless otherwise specified, and of the best quality and especially adapted to the services required.
- B. The Contractor shall furnish a superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen and labor required to unload, transfer, erect, connect up, adjust, start, operate, and test each system.
- C. The Contractor shall locate and install all equipment which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include, but not be limited to valves and unions. Minor deviations from the Drawings may be

made to allow for better accessibility, but changes of significant magnitude or changes involving extra cost shall not be made without approval of the Engineer.

1.03 STANDARDS

- A. Any reference to standards in the Contract Documents shall always imply the latest issue in effect including all amendments and errata at the time bids are taken, of said standards unless otherwise stated.
- B. Abbreviations for various organizations which may be used in these Specifications are as follows:

<u>Abbreviation</u>	<u>Organization</u>
AA	- Aluminum Association
AASHTO	- American Association of State Highway and Transportation Officials
ABMA	- American Bearing Manufacturers Association (formerly AFBMA)
ACI	- American Concrete Institute
ACS	- American Chemical Society
AGA	- American Gas Association
AGMA	- American Gear Manufacturers Association
AHDGA	- American Hot Dip Galvanizers Association
AICHE	- American Institute of Chemical Engineers
AISC	- American Institute of Steel Construction
AASHO	- The American Association of State Highway Officials
ABPA	- Acoustical and Board Products Association
AI	- The Asphalt Institute
AIEE	- American Institute of Electrical Engineers (Now IEEE)
AIMA	- Acoustical and Insulating Materials Association
AISI	- American Iron and Steel Institute
AMCA	- Air Moving and Conditioning Association
ANSI	- American National Standards Institute
API	- American Petroleum Institute
APWA	- American Public Works Association
AREA	- American Railway Engineering Association
ASA	- American Standards Association (Now ANSI)
ASCE	- American Society of Civil Engineering
ASHRAE	- American Society of Heating, Refrigerating, and Air Conditioning Engineers

<u>Abbreviation</u>	<u>Organization</u>
ASME	- American Society of Mechanical Engineers
ASSCBC	- American Standard Safety Code for Building Construction
ASTM	- American Society of Testing and Materials
AWPA	- American Wood Preservers Association
AWPB	- American Wood Preservers Bureau
AWS	- American Welding Society
AWWA	- American Water Works Association
BIA	- Brick Institute of America
CBRA	- Copper and Brass Research Association
C&P	- Chesapeake and Potomac Telephone Company
CIPRA	- Cast Iron Pipe Research Association
CRSI	- Concrete Reinforcing Steel Institute
CS	- Commercial Standard (U.S. Department of Commerce)
DOT Spec	- Road and Bridge Specifications Virginia Department of Transportation, 1991
E/A	- Engineer and/or Architect
EEl	- Edison Electric Institute
EPA	- U.S. Environmental Protection Agency
FM	- Factory Mutual
FTI	- Facing Tile Institute
FS	- Federal Specifications
GPM	- Gallons Per Minute
HP	- Horsepower
IEEE	- Institute of Electrical and Electronic Engineers
ID	- Inside Diameter
IPCEA	- Insulated Power Cable Engineers Association
MBE	- Minority Business Enterprise
MBMA	- Metal Building Manufacturers Association
MSS	- Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	- National Association of Architectural Metal Manufacturers
NBFU	- National Bureau of Fire Underwriters
NBS	- National Bureau of Standards
NCPI	- National Clay Pipe Institute
NCMA	- National Concrete Masonry Association
NEC	- National Electrical Code
NECA	- National Electrical Contractors Association
NEMA	- National Electrical Manufacturers Association
NFPA	- National Fire Protection Association
NPT	- National Pipe Threads
NSF	- National Science Foundation
OD	- Outside Diameter
OFCCP	- Office of Federal Contracts Compliance Programs
OSHA	- U. S. Department of Labor, Occupational Safety and Health Administration
PCA	- Portland Cement Association
PCI	- Prestressed Concrete Institute

<u>Abbreviation</u>	<u>Organization</u>
PS	- United States Products Standards
PSIG	- Pounds Per Square Inch Gauge
RPM	- Revolutions Per Minutes
SAE	- Society of Automotive Engineers
SCPI	- Structural Clay Products Institute
SDI	- Steel Decks Institute
SJI	- Steel Joists Institute
SPIB	- Southern Pine Inspection Board
SMACNA	- Sheet Metal and Air Conditioning National Association
SMSA	- Standard Metropolitan Statistical Area
SSPC	- Steel Structures Painting Council
STA	- Station (100 feet)
TDH	- Total Dynamic Head
TEMA	- Tubular Exchanger Manufacturers Association
UL	- Underwriter's Laboratories
USASI or	- United States of America Standards Institute
USAS	- (Now ANSI)
USGS	- United States Geological Survey
USC&GS	- United States Coast and Geodetic Survey

1.04 VERIFICATION OF DIMENSIONS

The Contractor shall be responsible for field verification of all dimensions of existing facilities and other items which are shown on the Contract Drawings.

1.05 TESTS OF MATERIALS AND EQUIPMENT

All material before being incorporated in the work shall be subject to inspection, testing and approval of the Engineer and any work in which such materials are used without prior test and approval shall be considered defective and unauthorized and will not be paid for. The Contractor shall perform such tests as required by the specifications in a timely fashion taking into account when the items will be incorporated in the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

End of Section

SECTION 01510

TEMPORARY FACILITIES

PART 1 GENERAL

1.01 DESCRIPTION

Furnish, install and maintain temporary utilities required for construction, and remove upon completion of Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electric Code.
- B. Comply with Federal, State, and local codes and regulations and with utility company requirements.
- C. Comply with Health Department Regulations.

PART 2 PRODUCTS

2.01 MATERIALS

Materials for temporary installations may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 CONTRACTOR'S FIELD OFFICE

While it is not anticipated for this project, the Contractor may furnish at his own expense, adequate field office facilities for his own use during the prosecution of the work, located at the site as approved by the Engineer. Upon completion of the work, the field office shall remain the property of the Contractor and shall be removed from the site. Contractor is responsible for coordinating and paying all utility service connection charges and the cost of such services should they be established.

2.03 TEMPORARY SANITARY FACILITIES

- A. Approved sanitary conveniences for the use of laborers and others employed on the work, properly secluded from public observation shall be constructed and maintained by the Contractor, in such manner and at such points as shall be approved or directed and their use shall be strictly enforced. The collections in the same shall be disinfected and/or removed when and as required.

- B. The Contractor shall provide and maintain, in a neat and sanitary condition, such accommodations for the use of his employees, as may be necessary to comply with the requirements and regulations of the Department of Health or of other bodies or tribunals having jurisdiction thereof. He shall commit no public nuisance.
- C. The sanitary facilities within the existing facilities shall not be used by employees and subcontractors of the Contractor.

2.04 CONTRACTOR'S STAGING AREA

- A. Owner will provide areas for Contractor's staging at the pre-construction conference.
- B. Provide storage sheds as required for the performance of the work and protection of materials and equipment.

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain and operate facilities to assure continuous service.
- B. Modify and extend facilities as work progress requires.

3.02 REMOVAL

- A. Completely remove temporary facilities when their use is no longer required, upon approval from the City.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore permanent facilities used for temporary services to specified condition.

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SPECIFIED EQUIPMENT, MATERIALS AND SUBCONTRACTORS

- A. The Contract Drawings and/or Specifications may specify the names of manufacturers, trade names, model numbers, types of equipment, materials or subcontractors to be used in the project. The Contract shall be based on the equipment, materials and subcontractors specified, or equal. Reference made to a particular product or model of a manufacturer is made to identify a particular design, quality, construction, arrangement, or style, etc.
- B. Where the Contractor proposes to use a substitute product or subcontractor for a named item, he shall submit to the Engineer complete information on and working drawings for such substitution, including all necessary redesign of structures, partitions, foundations, piping, ductwork, wiring, or of any other part of the project. All such redesign and all new drawings and detailing required therefore shall be prepared by the Contractor at the Contractor's expense. Let it be understood that where the substitution of any item or items require a different quantity and arrangement of structure, partitions, foundations, piping, ductwork, wiring, conduit and equipment from that specified or indicated on the Contract Drawings, the Contractor shall have included the total cost of such changes in the Contract. Later requests for additional money for substitutes will not be considered. It shall be expressly understood that all equipment, materials, suppliers, or subcontractors named in the specifications shall be furnished in full accordance with the Contract Drawings and Specifications.
- C. The attention of the Contractor is especially directed to the requirement that, if the Contractor proposes to substitute materials or equipment as "equals" to those specified, it shall be the Contractor's responsibility to furnish complete, specific, detailed information from the manufacturer or supplier of the material or equipment he proposes to furnish, in which the requirements of the contract specifications are shown to be met. This shall consist of a point by point comparison of the contract specification requirements with the material or equipment proposed to be furnished. In the event the contract specifications mention a model number and manufacturer, a point by point comparison of the equipment specified under the contract and the proposed substitutes shall be furnished by the Contractor. The burden of responsibility in furnishing this information is with the Contractor. If incomplete or irrelevant data is submitted as evidence of compliance with this section of the Specifications, the data will be returned to the Contractor and the request for approval will be denied.

1.02 ADDITIONAL MATERIAL AND/OR EQUIPMENT

Because of the small scale of the Drawings, all offsets, valves, fittings and accessories which may be required may not be shown. The Contractor shall carefully investigate the structural and finish conditions affecting his work and shall arrange his work accordingly, furnishing such fittings, valves, transitions, pull or junction boxes, and accessories as may be required to meet such conditions, at no additional cost to the City.

1.03 SINGULAR NUMBER

Where material, a device, or part of the equipment is referred to in the singular number, it is intended that such reference shall apply to as many items of material, devices or parts of the equipment as are required to complete the installation.

1.04 EQUIPMENT UNIFORMITY

All blowers, valves and other multiple-unit equipment shall be, to the greatest extent possible within its category, the product of a single manufacturer.

1.05 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

- A. All equipment and materials provided and work performed under this Contract shall be protected from damage before and after installation. The Contractor shall be responsible for work, equipment and materials until finally accepted by the City.
- B. During construction, the open ends of work shall be effectively closed with temporary caps or plugs to prevent the entry of foreign material.
- C. Where permanent equipment called for under this Contract is installed before the erection of adequate protective structures, the Contractor without additional compensation therefore, shall provide approved effective and durable covers for fully protecting such equipment against damage from the elements or from any other cause.
- D. Electrical equipment shall be carefully and effectively covered with waterproof material and otherwise protected at all times from the elements or any other source of damage.
- E. All existing and new structures, machinery, equipment, piping electric conduit, wiring, and accessories and appurtenances shall be adequately supported and safeguarded against all damage or injury during performance of work under this Contract. The Contractor shall be responsible for all damage or injury resulting from his operations and shall repair such damage immediately and to the satisfaction of the Engineer.
- F. The Contractor shall store and protect products in accordance with the manufacturer's recommendations, and the requirements specified herein.

- G. The Contractor shall make all arrangements and provisions necessary for the storage of materials and equipment. All construction equipment, and materials and equipment to be incorporated into the work shall be placed so as not to injure any part of the work or existing facilities, and so that free access can be achieved at all times to all parts of the work. Materials and equipment shall be kept neatly and compactly stored in locations that will cause a minimum of inconvenience.
- H. Areas available on the job site for storage of materials and equipment shall be as shown, specified or designated and approved by the Engineer. All materials and equipment must be consigned to the Contractor directly. No delivery of materials and equipment will be accepted by the City, and all expenses incurred by the City in handling materials or equipment which have been consigned or directed to the City, will be charged to the Contractor.
- I. Materials and equipment which are to become the property of the City shall be stored to facilitate their inspection and ensure preservation of the quality and fitness of the work, including proper protection against damage by freezing and moisture. They shall be placed in inside storage areas, unless otherwise shown, specified or approved by the Engineer. Materials and equipment whether installed or being stored prior to installation shall be protected in full accordance with the manufacturer's recommendations for safeguarding the items. Upon delivery of equipment the Contractor shall furnish the Engineer a copy of the manufacturer's recommendations for the proper storage and protection of the equipment.
- J. Contractor shall be fully responsible for loss of or damage to stored materials.
- K. Uncovered Storage:
1. The following types of materials may be stored out-of-doors without cover:
 - a. Masonry units
 - b. Reinforcing steel
 - c. Structural steel
 - d. Piping
 - e. Precast concrete items
 - f. Castings
 - g. Handrailing
 2. Store the above materials on wood blocking so there is no contact with the ground.
- L. Covered Storage:
1. The following type of material may be stored out-of-doors if covered with material impervious to water:

Rough lumber

2. Covers shall be tied down with rope, and sloped to prevent accumulation of water on covers.
3. The above materials shall be stored on wood blocking.

M. Fully Protected Storage:

1. The Contractor shall store all products not named above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.
2. Heated storage space shall be provided for materials which would be damaged by freezing.
3. Mechanical and electrical equipment shall be protected from being contaminated by dust, dirt and moisture.
4. Humidity shall be maintained at levels recommended by manufacturers for electrical and electronic equipment.

- N. Improper storage resulting in damage to materials to be incorporated into the work will result in rejection of damaged materials and will require replacement at no cost to the City.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION (Not used)

END OF SECTION

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SECTION 01650

START-UP

PART 1 - GENERAL

1.01 DESCRIPTION

Scope of Work: The work outlined in this section shall provide a procedure for the initial start-up. It is the intent of this procedure to demonstrate that the work, or individual facility as applicable, is complete and ready for acceptance.

1.02 DEMONSTRATION OF SYSTEMS

- A. Demonstrate the essential features of all systems as they apply to the Work.
- B. Each system shall be demonstrated only after satisfactory completion of testing.

1.03 DATE - TIME

A demonstration shall be held upon completion of all systems at a date and time to be agreed upon in writing by the City or his representative.

1.04 ATTENDING PARTIES

The demonstration shall be held by the Contractor in the presence of the City, and the manufacturer's representative (if applicable).

1.05 CERTIFICATE OF COMPLETED DEMONSTRATION

Submit five (5) copies of Certificate of Completed Demonstration memo signed by the Contractor, Subcontractor and City and insert one copy in each Operation and Maintenance Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PRELIMINARY MATTERS

- A. Prior to system start-up, successfully complete all testing required of the individual components of the work. Provide equipment manufacturer's certification that their components have been properly installed and are ready for start-up and City's inspection.

- B. Demonstrate to the Engineer that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their controls as designated.
- C. Coordinate start up activities with the City's operating personnel and with the Engineer prior to commencing system start-up.

3.02 START UP

- A. Confirm that all equipment is properly energized.
- B. Initiate start up in accordance with the operation and maintenance manuals.
- C. Observe the component operation and make adjustments as necessary to optimize the performance of Work.
- D. Coordinate with City for any adjustments desired or operational problems requiring debugging.
- E. Make adjustments as necessary.
- F. Acceptability of the Work's performance will be based on the Work performing as specified, under actual and simulated operating conditions. The intent of the start-up demonstration and testing is for the Contractor to demonstrate to the City and the Engineer that the Work will function as a complete and operable system and is ready for acceptance.

3.03 CERTIFICATE OF COMPLETION

Upon successful completion of the start-up Demonstration and Testing, the Contractor may request a certificate of Completion. Upon issue of the Certificate of Completion, the City will take over the operation of the work, and the one (1) year guarantee period will begin as of that date.

CERTIFICATE OF COMPLETED DEMONSTRATION MEMO

Note to Contractor: Do not submit this form at the time Operation and Maintenance Manual is submitted. Submit five copies of all information listed below for checking at least one week before scheduled completion of Work. After information has been approved and inserted in each brochure, give the City a demonstration of completed mechanical systems and have him sign five copies of this form. Provide one signed copy for each brochure. After this has been done, a written request for a final inspection of the system shall be made.

RE:

(Name of Project)

(Division Number and Name)

This memo is for the information of all concerned that the City has been given a Demonstration of Completed System on the work covered under this Division. This demonstration consisted of the system operation, a tour on which all major items of equipment were pointed out, and the following items were given to the City:

- (a) City's copy of Operation and Maintenance Manual containing approved submittals on all items, including the following: (To be inserted in the Operation and Maintenance Manual after the correct tab).
 - (1) Maintenance Information published by manufacturer on equipment items.
 - (2) Printed Warranties by manufacturers on equipment items.
 - (3) Performance verification information as recorded by the Contractor.
 - (4) Manufacturer's Certificate.
 - (5) Written operating instructions on any specialized items.
 - (6) Explanation of guarantees and warranties on the system.
 - (7) Approved shop drawings.
- (b) Prints showing actual "As-Built" conditions.
- (c) A demonstration of the System in Operation and of the maintenance procedures which will be required.

(Name of General Contractor)

By:

(Authorized Signature, Title & Date)

(Name of Subcontractor)

By:

(Authorized Signature, Title & Date)

Operations and Maintenance Manual, Instruction Prints, Demonstration and Instruction in Operation Received:

(Name of City)

By:

(Authorized Signature, Title & Date)

xc: City, Engineer, Contractor, Subcontractor, and General Contractor

END OF SECTION

DIVISION 2

**SITE WORK
(NOT USED)**

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DIVISION 3

**CONCRETE
(NOT USED)**

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DIVISION 4

**MASONRY
(NOT USED)**

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DIVISION 5

**METALS
(NOT USED)**

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DIVISION 6

**WOOD AND PLASTICS
(NOT USED)**

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DIVISION 7

**THERMAL AND MOISTURE
PROTECITON
(NOT USED)**

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DIVISION 8

**DOORS AND WINDOWS
(NOT USED)**

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DIVISION 9

**FINISHES
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DIVISION 10

SPECIALTIES
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DIVISION 11

**EQUIPMENT
(NOT USED)**

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DIVISION 12

FURNISHINGS
(NOT USED)

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DIVISION 13

**SPECIAL CONSTRUCTION
(NOT USED)**

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DIVISION 14
CONVEYING SYSTEMS
(NOT USED)

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DIVISION 15

MECHANICAL

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SECTION 15010

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, terms and conditions (division 0), general requirements (division 1), and all sections of the specifications apply to mechanical work.
- B. In the event these requirements conflict with the terms and conditions (division 0), and general requirements (division 1), the more stringent requirement shall apply.

1.02 SCOPE

- A. Mechanical work shall be complete and ready for satisfactory service.
- B. The contract drawings are diagrammatic and intended to convey the general arrangement of the work.

1.03 CODES AND STANDARDS

- A. Work shall be performed in accordance with the latest version of the following codes and standards:
 - 1. International Mechanical Code (IMC)
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - 3. Sheet Metal and Air Conditioning National Association (SMACNA)
 - 4. American Society of Testing and Materials (ASTM)
 - 5. American National Standards Institute (ANSI)
 - 6. International Plumbing Code (IPC)
 - 7. National Fire Protection Association (NFPA)
 - 8. Underwriter's Laboratories (UL)
 - 9. Factory Mutual (FM)
- B. If contract documents conflict with applicable codes, the requirements of the applicable codes shall apply.

1.04 PERMITS

- A. The contractor shall obtain and pay for permits and certificates of inspection required by the local regulating authorities.

1.05 SITE EXAMINATION

- A. The contractor shall examine the site and observe the conditions under which the work will be performed. No allowances will be made for errors or omissions resulting from the contractor's failure to completely examine the site.

1.06 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be new and installed in accordance with the manufacturer's instructions and conditions for warranty. If contract documents are in conflict with the manufacturer's conditions for warranty, equipment shall be installed in accordance with the manufacturer's instructions so as not to void manufacturer's warranties.

1.07 SUBCONTRACTOR AND MANUFACTURER LIST

- A. Within fifteen (15) calendar days of the contract award, the contractor shall submit a list of subcontractors and manufacturers to the engineer for approval.

1.08 SUBMITTALS

- A. Submittals shall be provided in accordance with Section 01300 - Submittals.
- B. No work shall be fabricated or equipment ordered until the engineer's approval has been given on the submittals.
- C. Approval of submittals by the engineer does not relieve the contractor of the responsibility to provide the equipment and materials specified in the construction documents.
- D. The contractor shall provide submittals for the following equipment and materials:
 - 1. Duct insulation
 - 2. Equipment insulation
 - 3. Valves
 - 4. Pumps: condensate
 - 5. Fan-coil units
 - 6. Heat pumps

7. Electric convection heaters
8. Duct accessories
9. Diffusers, registers, and grilles
10. HVAC controls

1.09 CLEARANCES

- A. The contractor shall insure that adequate clearance exists for the installation of work shown on the drawings and described in the specifications.

1.10 PENETRATIONS

- A. Piping penetrations through walls and floors shall be sleeved and caulked, and patched to match the adjacent construction. Provide chrome-plated escutcheons on piping penetrations in exposed locations.
- B. Duct penetrations through walls and floors shall be patched to match the existing construction.
- C. Penetrations through fire resistance rated walls, floors, or assemblies shall be fire-stopped in accordance with the applicable codes and standards.
- D. Penetrations through waterproof construction shall be sealed in accordance with the waterproofing manufacturer's instruction. Work shall be performed by approved contractors if required by the manufacturer to maintain the warranty on the material.

1.11 CLEAN-UP

- A. Throughout the course of the work, the contractor shall keep the premises free from the accumulation of dirt and debris.
- B. Upon completion of the work, the contractor shall clean the premises to the satisfaction of the Owner.

1.12 ACCESSIBILITY

- A. The contractor shall locate equipment which must be serviced, operated, or maintained in fully accessible locations. Equipment shall include, but not be limited to: valves, drains, cleanouts, dampers, controllers, filters, and motors.
- B. The contractor shall provide access panels (installed in walls or ceilings) or doors (installed in ductwork) that are required for access to concealed mechanical devices which require future inspection, repair, or adjustment.

1.13 MECHANICAL IDENTIFICATION

- A. Mechanical work including equipment, piping, and ductwork shall be identified as to its function, equipment number indicated on the drawings, and area served.
- B. Mechanical equipment shall be identified with engraved, color-coded laminated plastic markers with contact-type, permanent adhesive. Match equipment schedules on the drawings as closely as possible for equipment designations.
- C. Piping systems shall be identified with cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without the use of adhesive, tape or straps. Pipe identification shall be provided with flow arrows and lettering that is at least one inch high.

1.14 RECORD DRAWINGS

- A. Throughout construction, the contractor shall maintain at the site one set of prints in good condition indicating, in red ink, deviations from the original contract drawings.
- B. Upon completion of the work, the contractor shall provide the Owner with a reproducible set of record drawings clearly showing the path of systems, location of equipment, piping, and ductwork, and deviations from the original contract drawings.

1.15 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

- A. Upon completion of the work, the contractor shall thoroughly instruct the Owner's representatives for no less than eight (8) hours in the proper operation and maintenance of mechanical equipment and systems.
- B. Upon completion of the work, the contractor shall submit to the engineer for approval three (3) sets of operating and maintenance manuals (hard copies and electronic copies in searchable PDF format) for mechanical equipment. Included in each manual shall be all manufacturer's technical and product information including warranties, rated capacities, accessories, installation and start-up instructions, parts lists, air and water balancing reports, control diagrams, submittals, other pertinent information for each piece of equipment and other information requested by the Owner.

1.16 GUARANTEE

- A. The contractor shall guarantee mechanical work to be free from defects and installation deficiencies for a period of one year after the date of acceptance by the Owner.
- B. During the guarantee period, the contractor shall repair mechanical systems as required, including necessary parts and labor, at no cost to the Owner.

- C. The contractor shall deliver to the Owner warranties that extend beyond the guarantee period.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 15053
COMMON WORK RESULTS FOR HVAC
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SECTION 15053

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Supports and anchorages.

1.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.03 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.01 THERMOSTATS

- A. Manufacturers:
 - 1. Erie Controls.
 - 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
 - 3. Heat-Timer Corporation.
 - 4. Sauter Controls Corporation.
 - 5. tekmar Control Systems, Inc.
 - 6. Theben AG - Lumilite Control Technology, Inc.
- B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- C. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - 1. Set -Point Adjustment: Concealed.
 - 2. Set-Point indication: Concealed.
 - 3. Thermometer: Concealed.
 - 4. Orientation: Vertical.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.02 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. 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.

END OF SECTION

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SECTION 15062
HANGERS AND SUPPORTS FOR HVAC EQUIPMENT

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SECTION 15062

HANGERS AND SUPPORTS FOR HVAC AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Fastener systems.
 - 2. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.02 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel duct hangers and supports.
 - 2. Powder-actuated fastener systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.03 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Building Attachments: Unless otherwise indicated install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
- B. Spring Hangers and Supports: Unless otherwise indicated install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
- C. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- C. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- D. Load Distribution: Install hangers and supports so stresses from movement will not be transmitted to connected equipment.

3.03 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.04 PAINTING

- A. Touch Up: 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

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SECTION 15815

METAL DUCTS

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SECTION 15815

METAL DUCTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Single-wall rectangular and round ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
2. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design:** Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
- B. Structural Performance:** Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.03 SUBMITTALS

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

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

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Factory- and shop-fabricated ducts and fittings.
 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 4. Elevation of top of ducts.
 5. Dimensions of main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through partitions.
 10. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 11. Hangers and supports, including methods for duct and building attachment, and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- D. Field quality-control reports.

PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 ROUND DUCT AND FITTING FABRICATION

- A. Round, Spiral Lock Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Duct Joints:
 - 1. Ducts up to 26 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
 - a. Acceptable Manufacturers:
 - 1) Ductmate Industries, Inc.
 - 2) Lindab Inc.

- C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- D. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with 0.034 inch metal thickness for pressure classes from minus 2- to plus 2-inch wg:
 - 3. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 4. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- D. 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.

2.04 SEALANT AND GASKETS

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

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size,"
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Galvanized-steel shapes and plates

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as

indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts 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. 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.
- I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 SEAM AND JOINT SEALING

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.
 - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
 - a. Systems for residential occupancy.
 - b. Ducts that are located directly in zones they serve.
 - c. Ducts that have short runs from volume-control boxes to diffusers.
 - d. Return-air ceiling plenums.
- B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements."
 - 1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:

- a. Systems for residential occupancy.
- b. Ducts that are located directly in zones they serve.
- c. Ducts that have short runs from volume control boxes to diffusers.
- d. Return-air ceiling plenums.

3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 "Rectangular Duct Hangers Minimum Size,"; 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.

3.04 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
2. Test the following systems:
 - a. Supply air.
 - b. Exhaust Air.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before insulation application.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.06 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
2. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 5. Provide drainage and cleanup for wash-down procedures.

3.07 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- D. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
- E. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - 1. 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.
 - a. Velocity 1000 fpm (5 m/s) or Lower: .05 radius-to-diameter ratio and three segments for 90-degree elbow.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

END OF SECTION

SECTION 15820
DUCT ACCESSORIES
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SECTION 15820
DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Control dampers.
 - 2. Flange connectors.
 - 3. Turning vanes.
 - 4. Flexible connectors.
 - 5. Duct accessory hardware.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. 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.

2.02 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. McGill AirFlow LLC.
 - 3. Ruskin Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:

1. Hat shaped.
 2. Stainless-steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
- E. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Molded synthetic.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.
- G. Actuators: (For motor operated dampers)
1. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - a. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - b. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

2.03 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.04 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
 4. SEMCO Incorporated.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall.

2.05 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.

3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

2.06 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.
- C. Set dampers to fully open position before testing, adjusting, and balancing.
- D. Install test holes at fan inlets and outlets and elsewhere as indicated.
- E. Install flexible connectors to connect ducts to equipment.

- F. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- G. Install duct test holes where required for testing and balancing purposes.
- H. 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.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 15837

FANS

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SECTION 15837

FANS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Backward-inclined centrifugal fans.

1.02 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For centrifugal fans, Manufacturers shall include operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Lift and support units with manufacturer's designated lifting or supporting points.

PART 2 - PRODUCTS

2.01 BACKWARD-INCLINED CENTRIFUGAL FANS

- 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. Aerovent; a Twin City Fan Company.
 - 2. Buffalo Forge.
 - 3. Greenheck (Basis of Design).
 - 4. Penn Ventilator.
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate and fastened to shaft with set screws.
- E. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
 - 1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
 - 2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

- F. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.
 - 1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours
 - 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours
- G. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor Size: 1.5.
 - 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 - 3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 4. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 - 5. Motor Mount: Adjustable for belt tensioning.
- H. Accessories:
 - 1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 - 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 3. Inlet Screens: Grid screen of same material as housing.
 - 4. Enclosure Type: Totally enclosed, fan cooled.
- I. Capacities And Characteristics: As indicated on the Drawings

2.02 SOURCE QUALITY CONTROL

- A. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch.
- C. Install units with clearances for service and maintenance.
- D. Label new fans to match existing labeling.

3.02 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.

3.03 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust damper linkages for proper damper operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
 - 8. Remove and replace malfunctioning units and retest as specified above.

- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

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SECTION 15855
DIFFUSERS, REGISTERS, AND GRILLES

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SECTION 15855

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fixed face grilles.

B. Related Sections:

1. Division 15 Section "Duct Accessories" for volume-control dampers not integral to diffusers, registers, and grilles.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

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

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 REGISTERS AND GRILLES

A. Fixed Face Grille:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Nailor Industries Inc.
 - b. Price Industries.
 - c. Tuttle & Bailey.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: ¾ inch spacing on front blades.
5. Core Construction: Integral.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.

2.02 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

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

END OF SECTION

SECTION 15950

TESTING, ADJUSTING AND BALANCING

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SECTION 15950
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 SUMMARY

- A. Systems: Testing, adjusting and balancing specified in this Section includes the following systems.
 - 1. Air handling systems including supply, return, and exhaust.
- B. Related Sections: Refer to other Division 15 sections for:
 - 1. Basic Mechanical Requirements.
 - 2. Fans and Ventilators
 - 3. Air Terminal Devices
 - 4. Metal Ducts

1.02 QUALITY ASSURANCE

- A. Tester's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, who is not the installer of the system to be tested and is otherwise independent of the project.
- B. Codes and Standards: Provide testing, adjusting and balancing conforming to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and either NEBB or AABC the following:
 - 1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Comply with ASHRAE recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing.
 - 2. NEBB or AABC: Comply with NEBB'S "Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems" or comply with AABC MN-1 "National Standards," as applicable to mechanical air and hydronic distribution systems, and associated equipment and apparatus.
- C. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the

most recent calibration data and the final test report date shall not be over 2 years.

1.03 SUBMITTALS

- A. Test Reports: Provide certified test reports, signed by the test and balance supervisor who performed the work. In addition, have the reports certified by a Professional Engineer who is familiar with testing and balancing and the project, and is registered in the jurisdiction where testing is being conducted. The final reports shall include identification and types of instruments used, and their most recent calibration date and calibration date.
- B. Standards: The Contractor shall deliver a copy of either NEBB or AABC standards for testing and balancing work associated with the project. This document shall serve as specific guidance to construction engineers as to minimum requirements.
- C. Maintenance Data: Include, in maintenance manuals, copies of certified test reports and identification of instruments.
- D. Qualifications: The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work, the name of the certifying engineer, and the qualifications of the independent Registered Professional Engineer certifying the report.

1.04 AGENDA

- A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.
 - 1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
 - 2. The agenda shall include a general description of each air system with its associated equipment and operation cycles.
 - 3. The agenda shall include a list of all air flow and air terminal measurements to be performed.
 - 4. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.

5. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:
 - a. Air terminal configuration.
 - b. Flow direction (supply or exhaust).
 - c. Velocity corrections.
 - d. Effective area applicable to each size and type of air terminal.
 - e. Density corrections.
6. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date and calibration date.

1.05 JOB CONDITIONS

- A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met:
 1. Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment.
 2. Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
 3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal states.
 4. All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURERS (Not Used)

2.02 PATCHING MATERIALS

- A. Material: Seal, patch and repair ductwork and equipment drilled or cut for testing purposes.
 1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.

2.03 TEST INSTRUMENTS

- A. Standards: Utilize instruments and equipment of type, precision, and capacity as recommended in the following standards:
 - 1. NEBB "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. AABC Manual MN 1.
- B. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. A representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
- C. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against transfer standard instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.
- D. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser air flow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.01 PROCEDURES AND INSTRUMENTS, GENERAL

- A. Requirements: All systems and components thereof shall be adjusted to perform as required by drawings and specifications.
- B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.
- C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.
 - 1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
 - 2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow

meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.02 AIR SYSTEM PROCEDURES

- A. Adjustments: Adjust new and existing fans EF-7, EF-5, EF-1 and EF-15 systems to provide approximate design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant conditions. Adjusting and balancing of all systems shall be conducted during periods of the year approximating maximum seasonal operation.
- B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.
- C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).
- D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct connected fans (without adjustable pitch blades), provided system pressure is less than 1/2 inch W.G. and sound level criteria is met.
- E. Air Measurement: Where air quantity measuring devices are specified in other sections such systems shall be used as a cross check of portable measuring equipment.
- F. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals Inch Pound Edition."
- G. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take offs, and other turbulence generating devices, to optimize reliability of flow measurements.
- H. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda. Laboratory tests shall be conducted to prove of methodology when so directed. Such tests shall be conducted in conformance with applicable ASHRAE or American Society of Mechanical Engineers (ASME) codes and shall be made at no cost.

3.03 CERTIFIED REPORTS

- A. Submittals: Three copies of the reports described herein, covering air system performance, and air motion (fpm), shall be submitted prior to final tests and inspection.
- B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.
- C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious maloperation and design deficiencies.
- D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air balancing and who is not affiliated with any firm involved in the design or construction phases of the project. Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.04 AIR SYSTEM DATA

- A. Report: The certified report shall include, for each air handling system, the data listed below.
 - 1. Equipment:
 - a. Installation data
 - (1) Manufacturer and model
 - (2) Size
 - (3) Arrangement, discharge and class
 - (4) Motor hp, voltage, phase, cycles, and full load amps
 - (5) Location and local identification data
 - b. Design data
 - (1) Data listed in schedules on drawings and specifications.
 - c. Fan recorded (test) data
 - (1) cfm
 - (2) Static pressure
 - (3) rpm
 - (4) Motor operating amps motor operating bhp
 - 2. Duct Systems:

- a. Duct air quantities (maximum and minimum) main, submains, branches, outdoor (outside) air, total air, and exhaust
 - (1) Duct size(s)
 - (2) Number of Pitot tube (pressure measurements)
 - (3) Sum of velocity measurements (Note: Do not add pressure measurements)
 - (4) Average velocity
 - (5) Recorded (test) cfm vs. design cfm

- b. Individual air terminals
 - (1) Terminal identification supply or exhaust, location and number designation
 - (2) Type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area
 - (3) Design and recorded velocities in fpm (state "core," "inlet," etc., as applicable)
 - (4) Design and recorded quantities in cfm deflector vane or diffusion cone settings

3.05 FINAL TESTS, INSPECTIONS AND ACCEPTANCE

- A. Scope: Test shall be made to demonstrate that capacities and performance of air systems comply with contract requirements.
 - 1. At the time of final inspection, the Contractor shall recheck, random selection of data (air quantities and air motion) recorded in the certified report. In addition, all conference rooms shall be rechecked.
 - 2. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
 - 3. Selections for recheck (specific plus random), in general, will not exceed 10 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

- B. Retests: If tests elicit a measured flow deviation of 10 percent or more from that recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost.

- C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently

marked by the Contractor so that adjustment can be restored if disturbed at any time.
Devices shall not be marked until after final acceptance.

END OF SECTION

DIVISION 16
ELECTRICAL

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SECTION 16051
COMMON WORK RESULTS FOR ELECTRICAL
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SECTION 16051

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

- a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways or wireways, penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.

3.3 SLEEVE-SEAL INSTALLATION

- A. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION

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SECTION 16060
GROUNDING AND BONDING

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SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 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. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 4. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory 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, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

PART 3 - EXECUTION

3.1 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. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. 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.

3.3 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. 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 so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

- C. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans and blowers. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
- B. Report measured ground resistance that exceeds the following value:
 - 1. 10 ohms

END OF SECTION

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SECTION 16073

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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SECTION 16073

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 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.

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 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 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 single-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 and RMC 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 Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. 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.
 6. To Steel: Spring-tension clamps.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- 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 Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. 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

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SECTION 16075
ELECTRICAL IDENTIFICATION

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SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- 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.

PART 2 - PRODUCTS

2.1 POWER 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. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.

- C. Self-Adhesive 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 adhesive tape for securing ends of legend label.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches 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.

2.3 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a black background. Minimum letter height shall be 3/8 inch.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. 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

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

- D. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, 600 V or Less, for Branch Circuits More Than 30 A to ground: Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, 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 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. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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 instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. 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. Apply labels to disconnect switches and

protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: 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.

END OF SECTION

SECTION 16120
CONDUCTORS AND CABLES

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SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 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.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Branch Circuits Exposed: Type THHN-THWN, single conductors in raceway.

3.2 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. Identify and color-code conductors and cables according to Section 16075 "Electrical Identification."
- E. 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.
- F. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

END OF SECTION

SECTION 16130
RACEWAY AND BOXES

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SECTION 16130

RACEWAY AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. FMC: Zinc-coated steel.
- C. LFMC: Flexible steel conduit with PVC jacket.
- D. Fittings for Conduit (Including all Types and Flexible and Liquidtight) and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

2.2 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.

- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 12, unless otherwise indicated.
- C. Fittings and Accessories: Include 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: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA 12.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed: Rigid Steel Conduit.
 - 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 3. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch trade size.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- 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. Support raceways as specified in Section 16073 "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

- F. Install no more than the equivalent of three 90-degree bends in any conduit.
- G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION

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SECTION 16420
ENCLOSED CONTROLLERS

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SECTION 16420

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following enclosed controllers rated 600 V and less:
 - 1. Full-voltage magnetic.

1.2 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. N.C.: Normally closed.
- D. N.O.: Normally open.
- E. OCPD: Overcurrent protective device.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Magnetic Controllers: Full voltage, across the line, electrically held.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - c. Rockwell Automation, Inc.; Allen-Bradley brand.
 - d. Siemens Energy & Automation, Inc.
 - e. Square D; a brand of Schneider Electric.
 - 2. Configuration: Nonreversing.
 - 3. Contactor Coils: Pressure-encapsulated type.
 - 4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 - 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 - 6. Bimetallic Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 7. External overload reset push button.
- C. Combination Magnetic Controller: Factory-assembled combination of magnetic controller and disconnecting means.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

- b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- c. Rockwell Automation, Inc.; Allen-Bradley brand.
- d. Siemens Energy & Automation, Inc.
- e. Square D; a brand of Schneider Electric.

2. Nonfusible Disconnecting Means:

- a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
- b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

- 1. Dry and Clean Indoor Locations: Type 12.

2.3 ACCESSORIES

- A. Hand-Off-Auto selector switch.

- B. Pilot lights.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

3.2 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 16075 "Electrical Identification."
- 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.3 FIELD QUALITY CONTROL

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

3.4 ADJUSTING

- A. Set field-adjustable overload-relay pickup and trip ranges.

END OF SECTION