SECTION 00 00 00
COVER SHEET

CUMBERLAND COUNTY
NORTH CAROLINA

EMERGENCY SERVICES CENTER
CHILLER REPLACEMENT

500 EXECUTIVE PLACE
FAYETTEVILLE, NC 28305

CONSTRUCTION DOCUMENTS
NOVEMBER 22, 2023

TWC PROJECT #: 2877-P

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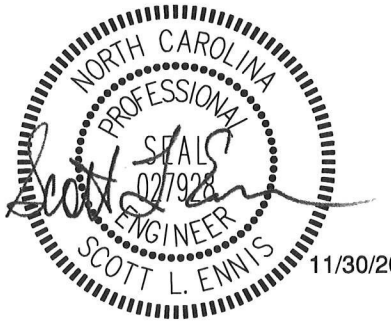
TABLE OF CONTENTS

SECTION 00 01 05

CERTIFICATIONS PAGE

A. Mechanical and Plumbing Specifications

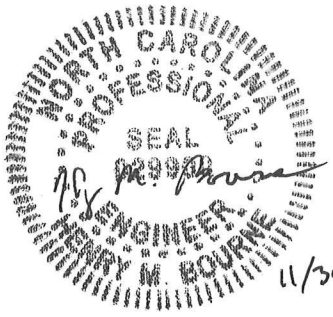
I, Scott L. Ennis, P.E., hereby certify that Division 23 of the, Cumberland County EMS Center - Chiller Replacement Project Manual were prepared by me or under my direct supervision.



11/30/2023

B. Electrical Specifications

I, Henry Bourne, P.E., hereby certify that Division 26 of the, Cumberland County EMS Center - Chiller Replacement Project Manual were prepared by me or under my direct supervision.



11/30/2023

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SECTION 00 11 13

ADVERSTIMENT FOR BIDS

INVITATION FOR PROPOSALS

FOR

CUMBERLAND COUNTY

ENGINEERING & INFRASTRUCTURE DEPARTMENT

Cumberland County EMS Center - Chiller Replacement, FAYETTEVILLE, NORTH CAROLINA

Cumberland County

North Carolina

A pre-bid conference will be held at 3:00 PM on December 19, 2023, at 500 Executive Pl, Fayetteville, NC 28305.

Pursuant to Section 143-131 of the General Statutes of North Carolina, informal bids are solicited and will be received in the office of the Cumberland County Engineering & Infrastructure Department, Room 214, in the Historic Courthouse located at 130 Gillespie Street, Fayetteville, North Carolina at any time before 2:30 PM on 01-09-2024, and then publicly opened in the office of the Cumberland County Engineering & Infrastructure Department in the Historic Courthouse and read for construction of the proposed:

Proposals must be enclosed in a sealed envelope addressed to Mr. JERMAINE WALKER, Engineering and Infrastructure Director, 130 Gillespie Street, Room 214, Fayetteville, NC 28301. The outside of the envelope must be marked “PROPOSAL FOR Cumberland County EMS Center - Chiller Replacement" and shall indicate the name, address, telephone number and state license number of the bidder. Proposals must be submitted on the printed form, or exact copies thereof, contained in the Contract Documents.

A bid bond is not required for this project.

Performance and Payment Bonds are required.

All Contractors are notified that North Carolina Statutory provisions as to licensing for Contractors will be observed in receiving, reading and awarding of contracts.

Plans and specifications, including Contract Documents, are open to public inspection and available upon request at the Cumberland County Engineering & Infrastructure Department Office, 130 Gillespie Street, Fayetteville, NC.

The County reserves the right to reject any or all proposals. The bidder to whom the contract may be awarded must comply with the requirements of G.S. Section 143-131, as amended.

No bids may be withdrawn after the scheduled closing time for the receipt of proposals for a period of forty-five (45) days.

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SECTION 00 42 00

PROPOSAL FORM

The undersigned hereby signifies that it is _____ (his or her) intention and purpose to enter into a contract to furnish labor, materials, equipment, apparatus, etc., as required and to do all the work necessary for the:

Cumberland County EMS Center - Chiller Replacement

as described in the specifications and shown on the plans in accordance with the terms of the Advertisement, Instructions to Bidders, the foregoing Specifications, and the following form of Contract, and this Proposal and the Plans; and pursuant with the requirements of the Advertisement and Instructions to bidders which are as follows:

THAT: The undersigned carefully examined the Instructions to Bidders, the Specifications, Plans, this form of Proposal, and the Contract and Fully understands them.

THAT: The undersigned carefully examined the site or sites of the project or projects and is familiar with the conditions under which the work, or any part of it, is to be done and the conditions which must be fulfilled in furnishing and/or erection or construction of any or all items of the project, and the furnishing only of any materials, equipment, or apparatus specified in connection therewith.

THAT: The undersigned will provide all necessary tools, machinery apparatus, and all means necessary to complete such Contract as may be entered into, and in the manner prescribed in the Contract and Specifications and according to the Plans and requirements under the of the Engineer, in the first class manner.

THAT: The right of Cumberland County and the recommendations of the Engineer are not to be questioned in the award of the Contract.

THAT: It is the intention of Cumberland County, North Carolina, subject to the conditions set forth, to award contracts for the project on the basis of bids received at this letting and in such manner as they may decide as being in the best interests of the County.

THAT: The County reserves the right to reject any of all proposals.

THAT: A proposal made by a corporation must be signed by its proper officers in a legal manner and its official address stated herein.

THAT: A proposal made by a firm shall be signed with the name of each member of said firm and the firm name added, with the official address of said firm.

THAT: The undersigned will complete such contract as is hereby proposed to enter into within the time stated in the notice to proceed and stipulated in the Contract.

THAT: The Bidder acknowledges receipt of the following Addendum (write in addendum #'s):

_____

THAT: The Contractor agrees to furnish all materials, labor and equipment and to install complete in place the work in accordance with the Plans and Specifications for the lump sum of:

BASE BID:

_____Dollars ($_____).

Total Bid ($_____).

Submitted, this _____day of _____, 2023.

_____

CONTRACTOR

By: _____
(Signature of Person, Firm or Corporation making Bid)

Title: _____

Address: _____

_____

Attest: _____

License No. _____

Phone: _____

INSTRUCTIONS ON PROPER SIGNING

If Contractor is an individual, sign on first line only and designate trade name below first line, thus:

John Jones (Seal)

Trading as [Type of Company Name Here]

If Contractor is a partnership, sign partnership name on first line; have at least one general (not limited) partner sign on second line, and put his designation as partner on third line, thus:

JONES PAVING COMPANY (Seal)
By: John Jones (Seal)
Title: General Contractor

If Contractor is a corporation, sign corporate name on first line (exactly as such name appears on the corporate seal); have the President or Vice-President sign on second line, put his title on third line, have the Secretary or Assistant Secretary sign on the left "ATTEST" line (adding the word "Assistant before the word "Secretary", if the Assistant Secretary is signing), and imprint corporate seal above the word "Attest", thus:

JONES PAVING COMPANY (Seal)
(Corporate Seal) John Jones
(Seal)
Title: President

ATTEST:

Thomas Jones

Assistant Secretary

SECTION 00 52 00

CONTRACT

THIS CONTRACT, made the _____ day of _____, [2024] between the County of Cumberland, a body politic and a subdivision of the State of North Carolina, hereinafter referred to as COUNTY, and _____, a business located at _____ hereinafter referred to as CONTRACTOR.

WITNESSETH:

THAT WHEREAS, a contract for the Cumberland County EMS Center - Chiller Replacement has recently been awarded to CONTRACTOR by the COUNTY, at and for a sum of:

($) as shown in the Proposal attached hereto:

AND WHEREAS, it is provided in said award that a formal contract would be executed by and between CONTRACTOR and the COUNTY, evidencing the terms of said award, and that CONTRACTOR would commence the work to be performed under this agreement on a date to be specified in a written order by the COUNTY, and would fully complete all work within 155 calendar days from the date the Notice to Proceed is issued.

NOW, THEREFORE, CONTRACTOR doth hereby covenant and agree with the COUNTY that it will well and faithfully perform and execute such work and furnish such labor, materials, equipment, apparatus, and supplies, in accordance with each and every one of the conditions, covenants, stipulations, terms, and provisions contained in said Specifications and in accordance with the Plans, at and for a sum named therefore in the Proposal attached hereto, and will well and faithfully comply with and perform each and every obligation imposed upon it by said Plans and Specifications and the terms of said award.

CONTRACTOR shall promptly make payments to all persons supplying materials in the prosecution of the work, and to all laborers and others employed thereon.

CONTRACTOR shall be responsible for all damages to the property of Cumberland County and other utilities that may be consequent upon the normal procedure of its work or that may be caused by or result from the negligence of the CONTRACTOR, its employees or agents, during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. CONTRACTOR must restore all property so injured to a condition as good as it was when CONTRACTOR entered upon the work.

CONTRACTOR shall furthermore be responsible for and required to make good at its expense any and all damages of whatever nature to persons or property, arising during the period of the Contract, caused by carelessness, neglect, or want of due precaution on the part of the CONTRACTOR, its agents, employees or workmen. CONTRACTOR shall also indemnify and save harmless the COUNTY, and the officers and agents thereof from all claims, suits, and proceedings of every name and description which may be brought against the COUNTY, or the officers and agents thereof, for or on account of any injuries or damages to persons or property received or sustained by any person or persons, firm or corporation, or by or in consequence of any materials used in said work or by or on account of any improper material or workmanship in its construction, or by or on account of any accident, or any other act or omission of CONTRACTOR, its agents, employees, servants, or workmen.

It is agreed and understood that the Advertisement for Bids, Instructions To Bidders, the General Conditions, the Specifications, the accepted Proposal, and the enumerated addenda and drawings are parts and parcels of this Contract, to the same extent as if incorporated herein in full.

It is further mutually agreed that, if at any time after the execution of this agreement and the surety bond hereto attached for its faithful performance, the COUNTY shall deem the surety or sureties upon such bond to be unsatisfactory, or if, for any reason, such bond ceases to be adequate to cover the performance of the work, CONTRACTOR shall at its expense, within five days after the receipt of notice from the COUNTY so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the COUNTY. In such event no further payment to CONTRACTOR shall be deemed to be due under this agreement until new or additional security for the performance of the work shall be furnished in manner and form satisfactory to the COUNTY.

And the COUNTY doth hereby covenant and agree with CONTRACTOR that it will pay to CONTRACTOR, when due and payable under the terms of said Specifications and said award, the above mentioned sum, and that it will well and faithfully comply with and perform each and every obligation imposed upon it by said Specifications and the terms of said award.

NON-APPROPRIATION CLAUSE: This agreement is subject to and contingent upon appropriation of funds for fiscal years subsequent to FY23.

E-VERIFY. CONTRACTOR shall comply with the requirements of Article 2 of Chapter 64 of the General Statutes. Further, if CONTRACTOR utilizes a subcontractor, CONTRACTOR shall require the subcontractor to comply with the requirements of Article 2 of Chapter 64 of the General Statutes.

Iran Divestment Act Certification. Contractor hereby certifies that Contractor, and all subcontractors, are not on the Iran Final Divestment List (“List”) created by the North Carolina State Treasurer pursuant to N.C.G.S. 147-86.55-69. Contractor shall not utilize any subcontractor that is identified on the List.

Whenever used herein, the singular shall include the plural, the plural the singular, and the use of any gender shall be applicable to all genders as the context may require.

IN TESTIMONY WHEREOF, CONTRACTOR and the COUNTY have duly signed and sealed this Contract.

(Imprint corporate seal below this line)

ATTEST: By: _____

_____ Title: _____

ATTEST:

For the COUNTY OF
CUMBERLAND COUNTY, NC

_____ By: _____

Marshall Faircloth, Chairman

This instrument has been Pre-audited in the manner Required by the local Government Budget and Fiscal Control Act.

Approved for Legal Sufficiency
upon formal execution by all parties
COUNTY ATTORNEYS OFFICE

_____ _____

County Finance Office

( ) Renewable ( ) Nonrenewable
Expiration Date:_____

INSTRUCTIONS ON PROPER SIGNING

If Contractor is an individual, sign on first line only and designate trade name below first line, thus:

_____John Jones_____ (Seal)

Trading as [Type Company Name Here]

If Contractor is a partnership, sign partnership name on first line; have at least one general (not limited) partner sign on second line, and put his designation as partner on third line, thus:

_____JONES PAVING COMPANY____(Seal)
By:_____John Jones_____ (Seal)

Title: _____General Contractor_____

If Contractor is a corporation, sign corporate name on first line (exactly as such name appears on the corporate seal); have the President or Vice-President sign on second line, put his title on third line, have the Secretary or Assistant Secretary sign on the left "ATTEST" line (adding the word "Assistant before the word "Secretary", if the Assistant Secretary is signing), and imprint corporate seal above the word "Attest", thus:

_____JONES PAVING COMPANY____(Seal)

(Corporate Seal) _____John Jones_____
(Seal)

Title: _____President_____

ATTEST:

____Thomas Jones_____

Assistant Secretary

SECTION 00 61 13

PERFORMANCE BOND

Contractor Name: Address:	**Surety** Name: Address:
Owner Name: Mailing Address	**Contract** Description Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: (date of Bond cannot be earlier than Effective Date of Contract) Modifications to this Bond Form: ___ None ___ See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

4. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

5. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

6. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

7. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

    4.1. After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

    4.2. Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

Definitions

1. Balance of the Contract Price—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

2. Construction Contract—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

3. Contractor Default—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

4. Owner Default—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

5. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.

If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

Modifications to this Bond are as follows: [Describe modification or enter “None”]

END OF SECTION

SECTION 00 61 14

PAYMENT BOND

Contractor Name: Address:	**Surety** Name: Address:
Owner Name: Mailing Address	**Contract** Description Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: (date of Bond cannot be earlier than Effective Date of Contract) Modifications to this Bond Form: ___ None ___ See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

Definitions

1. Claim—A written statement by the Claimant including at a minimum:
    1.1. The name of the Claimant;
    1.2. The name of the person for whom the labor was done, or materials or equipment furnished;
    1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
    1.4. A brief description of the labor, materials, or equipment furnished;
    1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
    1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
    1.7. The total amount of previous payments received by the Claimant; and

1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

2. Claimant—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

3. Construction Contract—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

4. Owner Default—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

5. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.

If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

Modifications to this Bond are as follows: [Describe modification or enter "None"]

END OF SECTION

SECTION 00 72 00

GENERAL CONDITIONS

A. The “General Conditions” referred to in this and the following section of the specifications is EJCDC “Standard General Conditions of the Construction Contract”, EJCDC No. C-700 (2013 Edition) and SHALL BE considered Section II of this specification by reference.

   1. A copy of the “General Conditions” may be examined in the office of the Cumberland County Engineering & Infrastructure Department.

B. Wherein the Supplementary Conditions are in conflict with the “General Conditions” (EJCDC No. C-700 (2013 Edition), the Provisions of the Supplementary Conditions SHALL govern.

C. All work is to be performed by Contractors licensed in their respective fields of competence.

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SECTION 00 73 00

SUPPLEMENTARY GENERAL CONDITIONS

GENERAL

The following Supplements modify, change, delete from or add to the "General Conditions of the Contract of Construction". Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

DEFINITIONS:

1. "Owner" or "County" - Cumberland County, North Carolina
2. "Engineer" - Cumberland County Engineering & Infrastructure Department
3. "Drawings" - All drawings, or reproductions of drawings pertaining to the construction under the Contract.
4. "Work" or "Project" - The work shown on the drawings and specified herein.

CONTRACT COMPLETION TIME AND LIQUIDATED DAMAGES:

The time for completion of the work including clean-up, under this contract shall be 155 calendar days from the date specified in a written "Notice to Proceed" to the Contractor(s). Liquidated damages in the amount of $500.00 per day for each day in excess of the time allowed will be deducted from the contract amount to be paid to the Contractor(s).

See General Conditions of the Contract, Article 12, regarding construction schedules, delays and extensions of time.

NORTH CAROLINA SALES TAX:

The following procedure shall be followed relative to the North Carolina Sales Tax applicable to this project. Contractors shall comply fully with the requirements outlined hereinafter, in order that the County may recover the amount of the tax permitted under the law.

a. It shall be the Contractor's responsibility to furnish the County documentary evidence showing the materials used and sales tax paid by the Contractor and each of his subcontractors. Such evidence shall be transmitted to the County together with the Contractor's monthly payment request on the form provided by the County.
b. The documentary evidence shall consist of a certified statement, by the Contractor and each of his subcontractors individually showing total purchases of materials from each separate vendor, total sales taxes paid to each vendor, and the county to which the local sales tax was paid. The certified statement must show the invoice number, or numbers, covered and inclusive dates of such invoices.
c. Materials used from Contractor's or subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.
d. The Contractor shall not be required to certify the subcontractor's statements.
e. The documentary evidence to be furnished to the County eligible for sales tax refunds covers sales taxes paid on building materials, supplies, fixtures and equipment which become a part of or annex to buildings or structures being erected, altered or repaired

under contracts with governmental units.

f. The Contractor to whom award is made on this project will be required to follow the procedure outlined above. Failure to comply with these requirements will result in delays in payment to the Contractor.

PLANS AND SPECIFICATIONS:

The Engineer will furnish to the Contractor two (2) copies of the Plans and Specifications, and the Contractor shall have available on the site at all times during the prosecution of the work one copy of said Plans and Specifications. This copy shall be accurately marked by the Contractor indicating all approved changes occurring during the construction process and delivered to the Engineer upon completion of the project.

MANUFACTURER'S RECOMMENDATIONS AND CERTIFICATION:

The Contractor shall submit to the Engineer for approval a list of proposed materials, equipment, or products to be incorporated in the work, within (10) days after award of the Contract.

The Contractor shall submit to the Engineer, the manufacturer's recommendations for each material or procedure to be utilized which is required to be in compliance with such recommendations. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless otherwise directed by the Engineer.

The Contractor shall be responsible at his own expense to provide certification to the Engineer by the manufacturer that all materials used for this project meet project specifications and are in compliance with referenced American Society for Testing Materials (ASTM). Materials or material suppliers shall not be changed after submittal or certifications without written approval by the Engineer. Any changes and re-certification cost shall be at the Contractor's expense and approval.

CONTRACTORS INSURANCE:

The Contractor shall not commence work under this Contract until he has obtained all insurance required below and submitted to the Owner in the form of a Certificate of Liability Insurance naming the County of Cumberland, P.O. Box 1829, Fayetteville, NC 28302 as the certificate holder, and such insurance has been approved by the Owner; nor shall the Contractor allow any subcontractor to commence work until such insurance has been obtained and approved. If a subcontractor does not take-out insurance in his own name and his principle Contractor wishes to provide insurance protection for such subcontractor and such subcontractor's employees, a rider must be attached to the principal policy, the Contractor must take out appropriate policies in the name of the subcontractor.

Minimum acceptable coverages are as follows:

Workers Compensation	Statutory
General Liability	$1,000,000
Vehicle Bodily Injury	$300,000 per Occurrence
	$500,000 Annual Aggregate
Property Damage	$500,000 Annual Aggregate

The Contractor and/or subcontractors shall furnish and keep in force the insurance requirements for a period of one (1) year after completion and acceptance of the work by the Owner. The certificate is to make reference to the project and the Owner.

FIELD DIRECTIVES FROM THE ENGINEER:

The Contractor shall communicate with and take field directives only from the Engineer or his representative. Any and all changes in the work are to be accomplished only by written change order or written field orders which can be issued only by the Engineer or his representative. No claims for monetary or other considerations will be allowed that are based on verbal agreements only or that are based on Contractor agreements with any agent other than the Engineer or his representative.

FORCE ACCOUNT WORK:

Should unforeseen circumstances arise which, in the opinion of the Engineer, require work to be done for which no price can be agreed upon, the Engineer may require that the work be done on a force account basis. Work done on this basis shall be paid as follows:

g. Skilled and common labor at the regular rate of pay for such men. Pay for the foreman may be included provided in the judgment of the Engineer, a foreman is required.
h. To the foregoing shall be added such social security and old age benefit payments made by the Contractor.
i. Materials used, to be listed with invoices.
j. Equipment used shall be paid for at an hourly rate schedule mutually agreed upon, but in no case shall it exceed the hourly rate schedule established for such units by the Associated General Contractors.

To the sum of a, b, c, and d shall be added ten percent (10%) for overhead and profit.

When force account work has been authorized, such authority shall be in writing.

LOCAL LAWS AND REGULATIONS:

The Bidder's attention is directed to the fact that all applicable state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full. The Contractor will be responsible for notifying proper inspectors at various stages of construction for inspection and approval before continuing his work.

PERMITS AND LICENSES:

The Contractor shall procure and pay all charges and fees for all permits and licenses incidental to the due and lawful prosecution of the work.

CONSTRUCTION TRASH & DEBRIS REMOVAL:

During construction of the Project, the Contractor shall be responsible for the removal of any trash or debris created by his work to an approved disposal site. The site will be maintained in a clean condition at all times. Trash and debris from daily operations are to be stored in appropriate storage containers or trucks until removal to the disposal facility.

PAYMENTS:

Payments shall be made on a basis of 95% of monthly estimated cost of labor and materials, including freight or hauling on receipted bills until the work is 50% complete. Upon completion of 50% of the work, no additional retainage shall be held provided the work is progressing satisfactorily. If the Contractor fails to maintain the work on schedule,

the Owner has the right to reinstate retainage such that the total amount withheld does not exceed 2.5% of the total contract amount. The contract payment shall be due and payable within fifteen (15) days after the Contractor's invoice has been certified for payment by the Engineer, the balance to be paid upon completion and acceptance of the job. Final payment shall be made to the Contractor within thirty (30) days after all work has been finally completed and each and every provision of the specifications and accompanying drawings comply with to the Owner's or Engineer's satisfaction. Acceptance of the completed job shall be made by the Owner or his representative and the Engineer not later than the 25th of the month following in order to receive consideration.

DISPUTE RESOLUTION:

The parties must resolve any claim, dispute or other matter in contention arising out of, or relating to, this Contract which involves $15,000 or more through the following procedure. The parties shall first negotiate in good faith to reach an equitable settlement to the dispute. If a negotiated settlement cannot be reached within 10 business days, the parties shall submit to mediation. The parties shall select a mediator, licensed by either North Carolina or federal courts and mutually agreeable to all parties in the dispute to conduct the proceedings which shall be held at the Owner’s place of business. If the parties cannot agree on the selection of a mediator within 10 business days, then the parties agree that the Cumberland County Attorney shall select the mediator. The mediators cost shall be equally shared by all parties to the dispute. If a mediated settlement cannot be reached, the final recourse to the aggrieved party is legal action instituted and tried in the General Court of Justice of North Carolina under North Carolina Law with venue for trial being Cumberland County. No party shall have a right to resort to litigation until mediation shall first have occurred and not been successful.

In accordance with North Carolina General Statute 143-135.26(12) and as a condition to this Contract, the prime CONTRACTOR shall incorporate this dispute resolution clause in any and all contracts with first-tier subcontractors who in turn shall incorporate this clause in any contracts with lower-tier subcontractors.

WARRANTY

The CONTRACTOR shall provide a 12-month warranty on all materials and workmanship beginning on the date of final acceptance.

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Cumberland County EMS Center - Chiller Replacement

B. Owner's Name: Cumberland County.

C. Engineer's Name: The Wooten Company.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 52 00 - Agreement Form.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings.

B. HVAC: Alter existing system and add new construction, keeping existing in operation.

C. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

1.04 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Arrange use of site and premises to allow:
   1. Owner occupancy.

C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.06 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

B. Coordinate construction schedule and operations with Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 20 days after date of Owner-Contractor Agreement.

E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization and bonds and insurance.

F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

G. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the General and Supplementary Conditions..

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. Execute certification by signature of authorized officer.

F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

H. Submit one electronic and three hard-copies of each Application for Payment.

I. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 30 00.
   2. Construction progress schedule, revised and current as specified in Section 01 30 00.
   3. State Tax Form if required.

1.05 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.

D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 21 00

ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Contingency allowance.

1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CONTINGENCY ALLOWANCE

A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

B. Funds will be drawn from the Contingency Allowance only by Change Order.

C. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.04 ALLOWANCES SCHEDULE

A. Contingency Allowance: Include the stipulated sum/price of $$15,000 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

D. Limit each request to a single proposed substitution item.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Time Restrictions:
   1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

B. Submittal Form (before award of contract):
   1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

3.04 ACCEPTANCE

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

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Contractor's daily reports.

H. Progress photographs.

I. Coordination drawings.

J. Submittals for review, information, and project closeout.

K. Number of copies of submittals.

L. Requests for Interpretation (RFI) procedures.

M. Submittal procedures.

1.02 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
   5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Submittal Service: The selected service is:

C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Submission of initial Submittal schedule.
   6. Designation of personnel representing the parties to Contract, Owner and Architect.

7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

B. Agenda:
1. Use of premises by Owner and Contractor.
2. Owner's requirements.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
10. Procedures for maintaining record documents.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.

5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 01 32 16

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

3.06 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.

C. Photography Type: Digital; electronic files.

D. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.

E. In addition to periodic, recurring views, take photographs of each of the following events:

F. Views:
1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
2. Consult with Architect for instructions on views required.
3. Provide factual presentation.
4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

G. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.07 REQUESTS FOR INTERPRETATION (RFI)

A. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the

issuance of a formal RFI.

B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
   2. Prepare using software provided by the Electronic Document Submittal Service.
   3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

C. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
   1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

3.08 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Submit at the same time as the preliminary schedule specified in Section - 01 32 16 - Construction Progress Schedule.
   2. Coordinate with Contractor's construction schedule and schedule of values.
   3. Format schedule to allow tracking of status of submittals throughout duration of construction.

3.09 SUBMITTALS FOR REVIEW

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

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.10 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Certificates.
   2. Test reports.
   3. Inspection reports.
   4. Manufacturer's instructions.
   5. Manufacturer's field reports.
   6. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.11 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.12 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.13 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a single transmittal for related items.
   2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
   3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
   4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Send submittals in electronic format via email to Architect.
   6. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 10 business days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
   7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   8. Provide space for Contractor and Architect review stamps.

9. When revised for resubmission, identify all changes made since previous submission.
10. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.

B. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

3.14 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt, but will take no other action.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. "Approved", or language with same legal meaning.
b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
2. Not Authorizing fabrication, delivery, and installation:
a. "Rejected".
1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
a. "Received" - to notify the Contractor that the submittal has been received for record only.
2. Items for which action was taken:
a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

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SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 MEETINGS

A. Pre-construction conference shall be held prior to the beginning of the Work.

B. Construction progress meetings shall be held monthly.

C. Project close-out conference shall be held during the final phases of the Work.

D. Engineer may schedule additional meetings.

E. Meetings scheduled by the Engineer shall be held at the Add Location.

F. Contractor's project superintendent shall attend meetings.

G. Notify suppliers and subcontractors to attend meetings as appropriate or as required by Engineer.

H. Contractor shall schedule pre-installation conferences as required in the individual specification sections.

I. Notify Engineer of project meetings scheduled by the Contractor.

J. Engineer will schedule and administer meetings throughout the progress of the Work, except for meetings held by the Contractor for normal coordination of the Work.

K. Meeting agenda shall include, but not be limited to, the following: Project Administration, Submittals, Construction Schedules and Methods, Safety and Health Regulations, Project Coordination, Payment Application, Change Orders, and Site Inspections.

L. Engineer will prepare agenda with copies to participants, preside at meetings, prepare minutes and distribute to participants for meetings scheduled by the Engineer.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOTUSED

END OF SECTION

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SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule.

B. Construction progress schedule, bar chart type.

1.02 SUBMITTALS

A. Within 10 days after date of Agreement, submit preliminary schedule.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.

D. Submit updated schedule with each Application for Payment.

E. Submit in PDF format.

1.03 SCHEDULE FORMAT

A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

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

3.02 CONTENT

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

B. Identify each item by specification section number.

C. Identify work of separate stages and other logically grouped activities.

D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

E. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

A. Include a separate bar for each major portion of Work or operation.

B. Identify the first work day of each week.

3.04 UPDATING SCHEDULE

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Annotate diagrams to graphically depict current status of Work.

D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

E. Indicate changes required to maintain Date of Substantial Completion.

F. Submit reports required to support recommended changes.

3.05 DISTRIBUTION OF SCHEDULE

A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. References and standards.

B. Testing and inspection agencies and services.

C. Control of installation.

D. Defect Assessment.

1.02 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.

C. Obtain copies of standards where required by product specification sections.

D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

1.03 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 21 00; see Section 01 21 00 and applicable sections for description of services included in allowance.

B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.03 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

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SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transportation, handling, storage and protection.

B. Product option requirements.

C. Substitution limitations.

D. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators 2021.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Containing lead, cadmium, or asbestos.

C. Motors: Refer to Section 21 05 13 - Common Motor Requirements for Fire Suppression Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

D. Motors: Refer to Section 22 05 13 - Common Motor Requirements for Plumbing Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

E. Motors: Refer to Section 23 05 13 - Common Motor Requirements for HVAC Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.

2.02 PRODUCT OPTIONS

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

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

I. Prevent contact with material that may cause corrosion, discoloration, or staining.

J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

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

END OF SECTION

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SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Cutting and patching.

D. Cleaning and protection.

E. Starting of systems and equipment.

F. Demonstration and instruction of Owner personnel.

G. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

H. General requirements for maintenance service.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

C. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.04 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

1.05 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.04 ALTERATIONS

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

B. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
b. Provide temporary connections as required to maintain existing systems in service.

4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

D. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

E. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

F. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

G. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

H. Clean existing systems and equipment.

I. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

J. Do not begin new construction in alterations areas before demolition is complete.

K. Comply with all other applicable requirements of this section.

3.05 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.06 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.07 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.08 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect and Owner seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.09 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.10 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.11 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

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

3.12 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.13 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Changes made by Addenda and modifications.

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

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
   1. Product data, with catalog number, size, composition, and color and texture designations.
   2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

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

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

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

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Provide a PDF copy, properly bookmarked as well.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

END OF SECTION

SECTION 23 05 00

HVAC GENERAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

A. Provide and coordinate all plans, labor, materials, apparatus, services, and equipment required for the installation of a fully operational HVAC system as shown in the contract documents.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 23.

B. Applicable Codes, Regulations and Standards:
   1. Latest Edition of the North Carolina State Building Code.
   2. Applicable National Fire Protection Association (NFPA) Codes.
   3. Applicable Underwriters Laboratory (UL) Standards. All electrical materials and equipment shall be UL listed and labeled in every case where such listing has been established.
   4. Latest Edition of the National Electrical Code (NEC, NFPA 70).
   5. Latest Edition of the National Electrical Manufacturers' Association (NEMA) Standards.
   6. Latest Edition of American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

1.03 SUMMARY

A. This Section includes general administrative and procedural requirements for HVAC installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in the general conditions.
   1. Submittals.
   2. Coordination drawings.
   3. Record documents.
   4. Maintenance manuals.
   5. Rough-ins.
   6. HVAC installations.

B. Related Sections:
   1. Specification Section 230513 "Electrical Requirements for HVAC Equipment", for factory-installed motors, disconnects, motor starters, controllers, accessories and connections.
   2. The drawings accompanying this specification are generally diagrammatic and do not show all details required for the complete system. They should however be followed as closely as possible in the general arrangement and location of equipment. Do not scale the drawings. Check all dimensions at the building and investigate all structural and finish conditions. Arrange all work to meet these conditions and provide such offsets, brackets and other necessary accessories as may be required.
   3. Immediately upon discovery of any discrepancy in the drawings or the specifications, or points of conflict therein, notify the Engineer who will clarify

such discrepancy in writing prior to the progress of the work beyond the point concerned.

4. Do not cover up construction until it has been inspected and approved by the Engineer.

1.04 SUBMITTALS

A. General: Follow the procedures specified in Division 1.

B. Increase, by the quantity listed below, the number of HVAC related shop drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Engineer. One additional copy of the shop drawings shall be submitted for Wake County Public School System Quality Control Review.
   1. Shop Drawings - 2 additional blue - or black-line prints.
   2. Product Data - 1 additional copy of each item.

C. Additional copies may be required by individual sections of these specifications. Upon completion of the project, provide the Owner with a complete set of all shop drawings and submittals as outlined in Paragraph D of this Section.

D. Shop Drawings and Catalog Data: Approval of submittals for any material, apparatus, devices and layouts shall not relieve the Contractor from the responsibility of furnishing same as specified of proper dimensions, size and quantity. If the submittals deviate from the contract documents in these three areas, advise the Engineer of the deviations in writing accompanying the shop drawings, including the reason for deviations. Any items found on the job either installed or not installed which do not meet the above criteria shall be replaced by the Contractor at the discretion of the Engineer. Review and stamp all shop drawings and submittals before submitting them to the Engineer for approval. Any submittals not stamped and signed by the Contractor prior to submittal to the Engineer will be returned to the Contractor for his stamp and resubmittal. A copy of all shop drawings and submittals shall be kept at the job site at all times.
   1. Required Submittals:
      a. Air Cooled Chillers
      b. Pumps
      c. Electrical Equipment (including motor starters and disconnects)
      d. Piping and Accessories
      e. Valves
      f. Pipe Hangers and Supports
      g. Piping Insulation and Jacketing
      h. Building Automation System
      i. Instrumentation
      j. Pipe Expansion Compensators
      k. Mechanical Identification
      l. Vibration Isolation
      m. Equipment Insulation
      n. Hydronic Specialties (Balancing Valves, etc.)
      o. Variable Speed Drives
      p. Testing & Balancing

1.05 COORDINATION DRAWINGS

A. Contractor is required to develop and distribute drawings for coordination with other trades. Drawings shall indicate size and elevation of ductwork and piping for HVAC

systems. Conflicts between HVAC system components and devices from other trades shall be brought to the Engineer's attention for resolution.

1.06 RECORD DOCUMENTS

A. The Contractor shall maintain as-built drawings at the job site and shall submit the drawings to the Engineer at the completion of work. The "As Built" drawings shall indicate the following installed conditions:
   1. The location of all equipment.
   2. Ductwork mains and branches, size and location, control devices, filters, boxes, and fan coil units.
   3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23, Section "Mechanical Identification."
   4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
   5. Approved substitutions, Contract Modifications, Alternates and actual equipment and materials installed.

B. During construction operations the Contractor shall faithfully and accurately record all changes from the contract drawings including dimensions where applicable, including invert elevations for all below-grade outside utilities with reference to permanent above-grade objects.

C. At project close-out, the Contractor shall neatly record with red ink all construction changes on an unused set of contract drawing prints supplied by the Engineer. This set of prints shall be submitted to the Engineer for review and approval. Should the Engineer find these record documents to be incomplete they will be returned to the Contractor and corrected accordingly by the Contractor with no additional cost to the Owner.

1.07 OPERATING AND MAINTENANCE MANUALS

A. Two (2) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.

B. The O. & M. Manuals shall be installed in a 3-ring heavy back note book with the name of the building and the words "Operations and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:
   1. Index and page numbers.
   2. Certificate of substantial completion.
   3. All warranties.
   4. List of all subcontractors and suppliers with names, addresses and phone numbers.
   5. Certified testing and balancing report.
   6. Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.
   7. Lubrication schedules and types of lubricants.
   8. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.

9. Equipment summary showing all capacities and ratings. (HP, Tons, KW, Filter size, etc.)
10. All submittal data and shop drawings.
11. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
12. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown and emergency instructions; summer and winter operating instructions.
13. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair and reassembly; aligning and adjusting instructions.
14. Wiring and control diagrams.
15. Manufacturer's cuts, part numbers and serial numbers.
16. A print of the main electrical control diagrams on non-fading paper shall be wall mounted under glass in each mechanical room. Show control sequence on the diagrams.

1.08 FINAL INSPECTIONS

A. Each project shall have both a pre-final and final inspection made before it is finally accepted by the Owner. A complete thorough training session shall be conducted by this Contractor and all applicable Subcontractors for the Wake County Public School System after the pre-final inspection.

B. The pre-final inspection shall be held after all systems are in place and in operation. The HVAC Contractor shall demonstrate to the Engineer and Owner that all systems in the building are properly installed, balanced, and performing as designed and specified. All Contractors and Subcontractors shall attend this inspection including HVAC and air and water balance Subcontractor.

C. The final inspection shall be held with the Owner, Architect/Engineer, all Contractors and Subcontractors to demonstrate to the Owner that all systems in the building are operating as designed and to their satisfaction.

1.09 WARRANTIES

A. All work shall be fully warranted for one year from the date of substantial completion by the Contractor who shall replace any defective materials and repair any defective workmanship.

1.10 TEST REPORTS

A. All systems are required to be tested and shall be documented in writing, listing date, item tests, section tested, witnesses to the test (signed), and specification section which requires testing. Reports on testing shall be submitted within seven (7) days of completion of each test. In addition all test reports shall be compiled in a spiral bound 8 1/2" x 11" document and submitted at the same time and in the same quantity as required for Operation and Maintenance manuals.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver the products to the project properly identified with names, model numbers, types, grades, compliance labels and other information needed for identification. All equipment and materials shall be fully protected and covered with protective materials to prevent any damage.

1.12 PRODUCT SELECTION

A. Where three or more manufacturers are listed for an item of equipment without an "or approved equivalent" clause, the Contractor may, at his option, provide any one of those specified. Equipment by manufacturers other than those listed will not be considered.

B. Where one or more manufacturers and a substitutions clause are listed for an item of equipment the Contractor may, at his option, provide the specified item or propose a substitute item of equal quality and performance. Submit a request for substitution for any manufacturer not named. Refer to Section II below regarding substitutions. The Engineer shall determine whether a substitute item is equivalent to the product specified and reserves the right to reject that substitute item.

C. All materials and equipment specified and shown on the plans shall be new and free from any defects. Each item of equipment shall bear the manufacturer's name or trade mark.

D. Dimensions: Insure that all items of equipment furnished fit the space available. Make necessary field measurements to ascertain space requirement.

E. Subcontractors and materials list: Provide within 5 days after execution of the contract a complete list of proposed Subcontractors and materials including manufacturer's name.

1.13 PRODUCT SUBSTITUTIONS

A. Engineer will consider requests for Product Substitutions in accordance with Division 1 of this specification.

B. Product Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed Product Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds that quality level of the specified product.
   2. Will provide the same warranty for the Substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitutions Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
   3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUPERVISION

A. The Contractor shall have a thoroughly competent foreman in charge of the construction work at all times. The foreman shall have extensive experience in the work to be performed.

3.02 ROUGH-IN OF DEVICES

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.03 COORDINATION

A. General: Sequence, coordinate, and integrate the various elements of HVAC systems, materials, and equipment with work of all other Contractors on the project. Comply with the following requirements:
   1. Coordinate HVAC systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements.
   3. Arrange for chases, slots, and openings in other building components during progress of construction to allow for HVAC installations.
   4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
   5. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
   7. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

3.04 WORKMANSHIP

A. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

B. Install HVAC equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

C. Duct and pipe penetrations: Duct and pipe penetrations shall be provided by the Mechanical Contractor. Mechanical shop drawings shall be provided to the Architect/Engineer and General Contractor with ALL duct and pipe penetrations sized and located. These shop drawings shall be submitted during early phases of construction so not to delay the General Construction Schedule. Any additional costs, associated with the construction delays, that result from a failure to

coordinate this work will be paid by the Mechanical Contractor.

D. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

E. Properly support all work and equipment installed under this contract. Study all drawings, shop drawings and catalog data to determine how equipment, accessories, piping, and related items are to be supported, mounted or suspended. Provide all bolts, inserts, pipe stands, brackets, structural supports and accessories for proper support of equipment furnished under this contract.

F. Provide suitable vibration isolating bases or suspension systems as indicated and/or required for all rotating, reciprocating and vibrating equipment. Design all isolation for maximum absorption efficiency so that no transmission of vibration or structurally borne noise shall occur. The selection of isolators for proper loading to obtain the desired efficiency shall be the responsibility of the manufacturer of the isolating units and shall be fully guaranteed by the manufacturer.

G. Pressure vessels and safety devices shall be inspected and approved by the N.C. Bureau of Boiler Inspectors as required by the code. Notify Boiler Inspector two weeks in advance in writing. Wall-mount the inspection certificate under glass in a metal frame.

H. All mechanical piping systems shall be thoroughly cleaned and flushed prior to their use for temporary cooling or heating. The HVAC Contractor shall contact the Architect/Engineer seven (7) days in advance of cleaning and flushing any mechanical piping systems. As the building is closed in, the HVAC Contractor shall be responsible for providing temporary cooling or heating through the permanent building system as required for general construction activities. This will require utilizing some portions of the mechanical piping systems and isolating others. Isolation of systems shall be accomplished through valves provided in the project. As general construction progresses, closed portions of the mechanical piping systems shall be opened to provide the necessary temporary heating or cooling. Each time a new portion of mechanical piping is opened to clean operating water system, the entire system shall be flushed and cleaned.

I. The HVAC Contractor shall include in his bid a price to clean and flush the heating hot water and chilled water systems or loop water system three (3) separate times in accordance with Specification Section 232113 and 232500.

J. All field painting of HVAC work, with exception of touch-up paint on factory finished equipment and exposed double wall spiral duct, shall be by HVAC Contractor in accordance with the "Painting" section of these specifications and Section 23 05 53. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat, and shall be repainted if necessary.

END OF SECTION

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SECTION 23 05 01

DIVISION OF WORK

PART 1 - GENERAL

1.01 DIVISION OF WORK

A. This section delineates the division of work between Divisions 23 (Mechanical) and Division 26 (Electrical).

B. This Contractor shall be responsible for the final electrical and the entire control connections and wiring to all equipment installed as part of his contract.

C. Contractor shall review the electrical plans, where applicable, to establish points of connection and the extent of his electrical work to be provided in his contract.

D. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor or as required by the existing conditions.

E. All power and control wiring shall be in conduits. Refer to electrical specifications for conduit and conduit fittings.

F. All electrical work shall be performed by a licensed electrician.

G. All electrical work shall be in accordance with the State Building Code and all its supplements, the latest edition of the National Electrical Code and the electrical specifications.

H. All other work necessary for the operation of Division 23 equipment shall be performed under Divisions 23.

PART 2 - PRODUCT

2.01 GENERAL REQUIREMENTS

A. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.

B. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.

C. All conductors and conduits shall be sized as noted on the plans or As required per NEC.

D. All individual motor starters and drives for mechanical equipment (i.e., fans, pumps, etc.) shall be furnished and installed under Division 23 unless indicated as a part of a motor control center. Motor starters provided in motor control centers and at motor control troughs shall be furnished under Divisions 26.

E. Under Division 26, power wiring rough-in shall be provided for junction box, trough, starter or disconnect switch, as required by the specific piece of equipment. Equipment final connections shall be provided under Division 23.

F. Equipment less than 110 volt, all relays, actuators, aquastats, freezestats, line and low voltage thermostats, disconnect switches, beyond termination point, and other appurtenances under Divisions 23 shall be furnished, installed and wired under Divisions 23 in accordance with Division 26.

G. All wiring required for controls and instrumentation not indicated on the drawings shall be furnished and installed by Division 23.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.

B. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid-Tite" conduit. Connection to other equipment shall be made with rigid conduit.

C. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015 (Reaffirmed 2020).

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators 2017.

C. NEMA MG 1 - Motors and Generators 2021.

D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

C. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.

B. Leeson Electric Corporation: www.leeson.com/#sle.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.

D. General Electric.

E. Marathon

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:
   1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
   2. Motors Larger than 3/4 Horsepower: 208/480 volts, three phase, 60 Hz as indicated on the drawings.

B. Nominal Efficiency:
   1. All motors shall be premium efficiency and meet or exceed the requirements of ASHRAE Standard 90.1-2013 and the North Carolina Energy Code.
   2. All motors shall conform to the efficiency standard for integral horsepower motors known as 10 CFR Part 431 Subpart B published by the US Department of Energy.

C. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

E. Motors driven by variable frequency drives (VFDs) shall be inverter duty and have a shaft grounding ring.

F. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

G. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Insulation System: NEMA Class B or better.

E. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

H. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

I. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

J. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

2.06 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Applications:
   1. Commercial:
      a. Motors part of other equipment
         1) Operating Mode: Constant speed.
         2) Input: Motor manufacturer to coordinate control requirements with the control board of the roof top unit and/or specified sequence of operation.

3) Input: Motor manufacturer to coordinate control requirements with the control board of the roof top unit and/or specified sequence of operation.
4) RPM: 600 through 1800.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

D. Motors with belt drives shall have adjustable motor mountings. Motor mounts shall have adjustable locking device for fixing motor position.

E. Motor starters shall be installed as close to the motors they are serving as possible.

F. Motor starters shall be installed at locations and heights to meet all State requirements and National Electric Code.

END OF SECTION

SECTION 23 05 19

METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

A. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers 2014 (Reapproved 2020).

B. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers 2014 (Reapproved 2021).

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
   3. Omega Engineering, Inc: www.omega.com/#sle.
   4. U.S. Gauge.

B. Pressure Gauges: Liquid filled, 316L stainless steel case and bezel ring, seamless 316L stainless steel bourdon tube, 304 stainless steel movement, 316L stainless steel process connection, with front recalibration adjustment, white aluminum dial with black lettering.
   1. 4" diameter
   2. Range: 0-100 psi or to match system pressure
   3. 3. Accuracy: +/- 1% of full scale
   4. Window: Shatter resistant glass or polycarbonate

5. Pointer: Aluminum, black painted
6. Working Pressure: 125% of full scale
7. Working temperature:
    a. Ambient: -40 - 140 Degrees F
    b. Fluid: -4 - 212 Degrees F
8. Weather Protection: NEMA 4X/IP67
9. Liquid: Glycerin, Mineral oil, or Silicon oil

C. Gauges used on cooling tower pumps shall be compound gauges.

2.02 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

2.03 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc; _____: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.
6. Range:
    a. Chilled Water: 0 - 120 Degrees F
    b. Hot Water: 30 - 180 Degrees F

2.04 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

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

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometers in air duct systems on flanges.

F. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

G. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Locate test plugs adjacent to pressure gages and pressure gage taps and thermometers and thermometer sockets.

END OF SECTION

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SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

1.02 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. TFE: Tetrafluoroethylene.

I. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch 2013 (Reaffirmed 2018).

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.

C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

E. ASME B31.9 - Building Services Piping 2020.

F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.

G. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings 2004 (Reapproved 2019).

H. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).

I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).

J. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings 2017.

K. AWWA C606 - Grooved and Shouldered Joints 2022.

L. MSS SP-67 - Butterfly Valves 2022.

M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.

N. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends 2010, with Errata .

O. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided 2018.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
   1. See Section 01 60 00 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.
   2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
   5. Secure check valves in either the closed position or open position.
   6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:
   1. Handle large valves with sling, modified to avoid damage to exposed parts.
   2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide all valves of each type from a single manufacturer.

B. Manufacturers:
   1. Anvil
   2. Apollo
   3. Crane
   4. Hammond

C. ITT Grinnell

D. Milwaukee

E. Nibco

F. Powell

G. Victaulic

2.02 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:
   1. Isolation (Shutoff): Butterfly and Ball.
   2. Swing Check (Pump Outlet):
      a. Size 2 inch and Smaller: Bronze with bronze disc.
      b. Size 2-1/2 inch and Larger: Iron with center-guided with resilient seat.
   3. Dead-End: Butterfly, single-flange (lug) type.

C. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.

D. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. Size 2 inch and Smaller: Threaded ends.
      b. Size 2-1/2 inch and Larger: Grooved ends.
   2. Copper Tube:
      a. Size 2 inch and Smaller: Threaded ends, except solder-joint valve-ends.
      b. Size 2-1/2 inch and Larger: Grooved ends.

E. Chilled Water Valves:
   1. Size 2 inch and Smaller, Bronze Valves:
      a. Threaded ends for steel pipe.
      b. Soldered ends for copper pipe.
      c. Ball: Full port, two piece, stainless steel trim.
      d. Swing Check: Bronze disc, Class 150.
   2. Size 2-1/2 inch and Larger, Iron Valves:
      a. 2-1/2 inch to 4 inch: Flanged ends.

b. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
c. Center-Guided Check: Compact-wafer, metal seat, Class 150.

2.03 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Handwheel: Valves other than quarter-turn types.
2. Hand Lever: Quarter-turn valves 6 inch and smaller.

D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: Extended neck.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
1. Building Services Piping Valves: ASME B31.9.

G. Bronze Valves:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.04 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 400 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. End Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.
9. Handle: Provide lever handle with 2-1/4" stem extension for insulation. On chilled water valves or other fluids below ambient temperature, use non-conductive handle extensions.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Wafer Style:
   1. Comply with MSS SP-67, Type I.
   2. Lug Style, CWP Ratings:
      a. Vacuum Service: Down to 29.9 in-Hg.
   3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
   4. Stem: One or two-piece stainless steel.
   5. Seat: EPDM.
   6. Disc: Aluminum-bronze.
   7. Operator: Lockable handle over direct-mount actuator base.

2.06 BRONZE, SWING CHECK VALVES

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

2.07 IRON, CENTER-GUIDED CHECK VALVES

A. Class 150, Compact-Wafer:
   1. Comply with MSS SP-125.
   2. Sizes 2-1/2 to 12 inch: CWP Rating; 300 psi.
   3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
   4. Resilient Seat: EPDM or NBR.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.
   2. Orient center-guided into horizontal or vertical position, between flanges.

E. Provide chainwheels on operators for valves 6" and larger where located 96" or more above finished floor, terminating 60" above finished floor.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping 2023.

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2022).

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures 1999 (Reapproved 2022).

H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2023.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Pipe Supports:
   1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
   2. Liquid Temperatures Up To 122 degrees F:
      a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
      b. Support From Below: MSS SP-58 Types 35 through 38.
   3. Operating Temperatures from 122 to 446 degrees F:
      a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.

C. Pipe Hangers:
   1. Clevis Hangers, Adjustable:
      a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.

D. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

E. Pipe Shields for Insulated Piping:
   1. General Construction and Requirements:
      a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.

b. Shields Material: UV-resistant polypropylene with glass fill.
c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
d. Minimum Service Temperature: Minus 40 degrees F.
e. Maximum Service Temperature: 178 degrees F.
f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

G. Secure fasteners according to manufacturer's recommended torque settings.

H. Remove temporary supports.

3.02 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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SECTION 23 05 33

HEAT TRACING FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Self-regulating parallel resistance electric heating cable.

1.02 REFERENCE STANDARDS

A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications 2022.

B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.

B. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for electric heat tracing.

C. Shop Drawings: Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.

D. Sizing table indicating pipe size, insulation thickness, fluid temperature, ambient temperature, and W/ft of cable selected.

E. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.

F. Field Quality Control Submittals: Indicate test reports and inspection reports.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 WARRANTY

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

B. Provide two year manufacturer warranty for cables, connection kits, accessories, and controls.

PART 2 PRODUCTS

2.01 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Manufacturers:
   1. Chromalox, Inc: www.chromalox.com/#sle.
   2. Pentair: www.pentairthermal.com/#sle.
   3. Thermon Manufacturing Company: www.thermon.com/#sle.
   4. Raychem.

B. Provide products listed, classified, and labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction (AHJ).

C. All heat-tracing applications with continuous exposure temperatures from 150 degrees F to 250 degrees F or intermittent exposure temperatures from 185 degrees F to 420 degrees F shall use self-regulating cables.

D. Self-regulating cable shall vary its power relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

E. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
   1. Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
   2. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.

F. All cables shall be capable of passing a 2.5 kV dielectric test for one minute (ASTM 2633) after undergoing a 0.5 kg-m impact.

G. Factory Rating and Testing: Comply with IEEE 515.1.

H. Heating Element:
   1. Provide pair of parallel No. 16 nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
   2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
   3. Capable of crossing over itself without overheating.

I. Minimum Self-Regulating Indices:

J. Heating Cable S.R. Index (W/deg F)

Heating Cable	S.R. Index (W/deg F)
3 W/ft	0.038
5 W/ft	0.060

8 W/ft	0.074
10 W/ft	0.100

K. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit as measured by the temperatures of 50 degree F and 100 degree F and confirmed by the type of test and published data sheets.

L. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal run-away and self-ignition, the cable shall produce less than 0.5 watts per foot when energized and heated to 350 degrees F for 30 minutes. After this test, if the cable is reenergized, it must not have an increasing power output leading to thermal runaway.

M. The self-regulating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50 degrees F and 210 degrees F, allowing at least six minutes of dwell time at each temperature.

N. Insulated Jacket: Flame retardant polyolefin.

O. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.

P. A integral ground-fault protection device set at 30 mA, with a nominal 100-ms response time, shall be included and used to protect each circuit.

Q. Maximum Power-On Operating Temperature: 150 degrees F.

R. Maximum Power-Off Exposure Temperature: 185 degrees F.

S. Electrical Characteristics:

2.02 OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

E. Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.

F. Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.03 CONNECTION KITS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.

C. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.

D. Provide UV stabilized components.

2.04 ACCESSORIES

A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
   1. High temperature, glass filament tape for attachment of heating cable to metal piping.
   2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
   3. Heat-conductive putty.
   4. Cable ties.
   5. Silicone end seals and splice kits.
   6. Installation clips.
   7. Warning labels for attachment to exterior of piping insulation. Refer to Section 23 05 53.
   8. Provide integral GFCI protection for all heat trace.

2.05 CONTROLS

A. Pipe Mounted Thermostats:
   1. Remote bulb on capillary, resistance temperature device (RTD) or thermistor for direct sensing of pipe wall temperature.
   2. Provide pilot light indicator.
   3. Provide a Control Enclosure for each chiller.
   4. Control Enclosure: Corrosion resistant and waterproof.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping and equipment are ready to receive work.

B. Verify field measurements are as indicated on shop drawings.

C. Verify required power is available, in proper location, and ready for use.

3.02 PREPARATION

A. Clean all surfaces prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer.

3.03 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.

C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

D. Comply with all national and local code requirements.

E. Identification:
   1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 ft including cladding over each valve or other equipment that may require maintenance.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Field Testing and Inspections:
   1. Commission system in accordance with installation and operation manual.
   2. Inspect for sources of water entry and proper sealing.
   3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
   4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
   5. Test heating cable integrity with megohmmeter at the following intervals:
      a. Before installing the cable.
      b. Prior to initial start-up (commissioning).
   6. Measure voltage and current at each unit.
   7. Controls:
      a. Verify control parameters are set to the application requirements.
   8. Submit written test report showing values measured on each test for each cable.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

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SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Vibration-isolated equipment support bases.

C. Vibration isolators.

1.02 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.03 REFERENCE STANDARDS

A. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
   1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.

C. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

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

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

D. Equipment Isolation: Isolate all motor driven mechanical equipment, unless otherwise noted, from building structure, and from systems which they serve, to prevent equipment vibrations from being transmitted to structure. Unless specifically indicated, follow the latest edition of ASHRAE Application Handbook - Sound and Vibration Control, or manufacturer's recommendations for isolator selection, whichever is more stringent.
1. Select and locate isolators to produce uniform loading and deflection. Use a minimum of 4 isolators to support each piece of equipment.
2. Select vibration isolation devices based on the lowest operating speed of equipment.

E. Piping Isolation:
1. Provide vibration isolators for piping supports:
a. Located in equipment rooms.
b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
2. Minimum Static Deflection:
a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.

2.02 VIBRATION ISOLATORS

A. Manufacturers:

1. Vibration Isolators:
    a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
    b. Mason Industries: www.mason-ind.com/#sle.
    c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
    d. Vibro-Acoustics: www.vibro-acoustics.com/#sle.
    e. The VMC Group/Amber Booth.
2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
    a. Color code or otherwise identify springs to indicate load capacity.
    b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    f. Selected to function without undue stress or overloading.

C. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
    a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
    c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
    a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Restrained Spring Isolators, Nonseismic:
    a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
    b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    c. Furnished with integral leveling device for positioning and securing supported equipment.
    d. Provides constant free and operating height.
4. Resilient Material Isolator Hangers, Nonseismic:
    a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Spring Isolators:
      a. Position equipment at operating height; provide temporary blocking as required.
      b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
      c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
   2. Isolator Hangers:
      a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
      b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
   3. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   4. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   5. Adjust isolators to be free of isolation short circuits during normal operation.
   6. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

1.02 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags. Key to control schematic.

B. Control Panels: Nameplates.

C. Heat Transfer Equipment: Nameplates.

D. Instrumentation: Tags.

E. Major Control Components: Nameplates.

F. Piping: Pipe markers.

G. Pumps: Nameplates.

H. Relays: Tags.

I. Small-sized Equipment: Tags.

J. Tanks: Nameplates.

K. Valves: Tags and ceiling tacks where located above lay-in ceiling.

L. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:
   1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com.
   2. Brimar Industries, Inc: www.pipemarker.com/#sle.
   3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
   4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.

B. Letter Color: Black.

C. Letter Height: 1/4 inch.

D. Background Color: White.

E. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
   2. Brady Corporation: www.bradycorp.com/#sle.
   3. Brimar Industries, Inc: www.pipemarker.com/#sle.
   4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
   5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   6. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
   3. Insite Solutions, LLC: www.stop-painting.com/#sle.
   4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
   2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
   3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
   4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
   5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
   6. Ductwork and Equipment: 2-1/2 inch high letters.

C. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 09 91 23.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. All piping and duct shall be labeled at least once in EVERY room. Piping and ductwork shall be labeled every 15 ft and at every change of direction.

G. Identify control panels, manual motor starters, combination motor starters, disconnects, variable frequency drives, boiler override switches, boiler emergency switches, and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with valve labels.

I. Tag automatic controls, instruments, and relays. Key to control schematic.

J. Identify Chillers with plastic nameplates indicating chiller number, area served, date of substantial completion and warranty duration and capacity in Tonnage.

K. Identify pumps with plastic nameplates indicating pump number, system served, GPM, and feet of head.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of hydronic systems.

1.02 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority and HVAC controls contractor.
   3. Include at least the following in the plan:
      a. Indicate standard to be followed (AABC or NEBB)
      b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      d. Identification and types of measurement instruments to be used and their most recent calibration date.
      e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      f. Final test report forms to be used.
      g. Details of how TOTAL flow will be determined; for example:
         1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
         2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
      h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
      i. Confirmation of understanding of the outside air ventilation criteria under all conditions.
      j. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
      k. Method of checking building static and exhaust fan and/or relief damper capacity.
      l. Time schedule for TAB work to be done in phases (by floor, etc.).
      m. Description of TAB work for areas to be built out later, if any.
      n. Time schedule for deferred or seasonal TAB work, if specified.

o. False loading of systems to complete TAB work, if specified.
p. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
q. Interstitial cavity differential pressure measurements and calculations, if specified.
r. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
s. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Field Logs: Submit at least twice a week to the Commissioning Authority and Construction Manager.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.
7. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Report date.

F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

1.04 QUALITY ASSURANCE

A. The TAB agency shall be a subcontractor of the General Contractor (or Construction Manager) and shall report directly to and be paid by the General Contractor.

B. The TAB agency shall be either a certified member of AABC or NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein.

C. Any agency that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.

D. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

E. TAB Specialist shall be identified by the General Contractor within 60 days after the notice to proceed. The TAB specialist will be coordinating, scheduling and reporting all TAB work and related activities and will provide necessary information as required by the Resident Engineer. The responsibilities would specifically include:
   1. Shall directly supervise all TAB work.
   2. Shall sign the TAB reports that bear the seal of the TAB standard. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC, TABB or NEBB.
   3. Would follow all TAB work through its satisfactory completion.
   4. Shall provide final markings of settings of all HVAC adjustment devices.
   5. Permanently mark location of duct test ports.
   6. Shall document critical paths from the fan or pump. These critical paths are ones in which are 100% open from the fan or pump to the terminal device. This will show the least amount of restriction is being imposed on the system by the TAB firm.

F. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB

1.05 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee AABC or NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.
   3. Warranty Period: Five (5) years.

PART 2 PRODUCTS

2.01 PLUGS

A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.02 INSULATION REPAIR MATERIAL

A. Refer to individual insulation sections for repair of insulation removed or damaged during TAB work.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. For each air handling system, provide a graphical static pressure profile indicating the pressure drop across each component of the air handling unit (filter, coils, dampers, wheel, etc).

3.02 PRE-CONSTRUCTION TAB WORK

A. Coordinate with General Contractor and Owner on scheduling pre-construction TAB measurements work prior to the start of demolition work.

B. Inspect each existing System to ensure it is operational, including controls. Provide report of any existing deficiencies to the Engineer.

C. Measurements shall be made to document the existing systems' performance prior to the start of

D. The data to be measured and recorded for each piece of equipment, coil, etc., shall be the same as listed below for the "New" work.

3.03 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Air coil fins are cleaned and combed.
5. Hydronic systems are flushed, filled, and vented.
6. Pumps are rotating correctly.
7. Proper strainer baskets are clean and in place.
8. Service and balance valves are open.
9. Clean and set automatic fill valves for required system pressure.
10. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
11. Check air vents at high points of systems and determine if all are installed to bleed air completely.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.04 PREPARATION

A. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

B. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

C. Compare design to installed equipment and field installations.

D. Walk the system to determine variations of installation from design.

E. Check filters for cleanliness.

F. Lubricate all motors and bearings.

3.05 ADJUSTMENT TOLERANCES

A. Water System Tolerances

Systems - Water	Tolerances of Plan Design	Remarks
Coils, Heat Exchangers, Pumps, Evaporators, Condensers	+/- 5%	

3.06 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 5 percent. When measuring a single point, repeat

readings until 2 consecutive identical values are obtained.

F. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

G. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

H. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

I. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

J. Seal ducts and piping, and test for and repair leaks.

K. Seal insulation to re-establish integrity of vapor barrier.

L. Retest, adjust, and balance systems subsequent to significant system modifications and resubmit test results.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

G. The TAB report shall indicate the critical circuit, which coils were closed for diversity (if applicable), and how the differential pressure setpoint was established.

3.08 SCOPE

A. Test, adjust, and balance the following:
   1. HVAC Pumps.
   2. Air Cooled Water Chillers.
   3. Air Handling Units.

B. This Section does NOT include:
   1. Testing boilers and pressure vessels for compliance with safety codes.
   2. Specifications for materials for patching mechanical systems.

3. Specifications for materials and installation of adjusting and balancing; refer to the respective system sections for materials and installation requirements.
4. Requirements and procedures for piping systems leakage tests.

3.09 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. V-Belt Drives:
1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D. Chillers:
1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

END OF SECTION

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SECTION 23 07 16

HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Jacketing and accessories.

1.02 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2019).

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

E. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017 (Reapproved 2023).

F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2023.

G. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation 2021.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.

I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

J. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth 2016b.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
   1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 1,200 degrees F.
   3. Density: 15 pcf.

B. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement: ASTM C449.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:
   1. Aeroflex USA, Inc; AEROFLEX EPDM Sheet/Roll: www.aeroflexusa.com/#sle.
   2. Armacell LLC; ArmaFlex Ultra with FlameDefense: www.armacell.us/#sle.
   3. K-Flex USA LLC; Insul-Sheet: www.kflexusa.com/#sle.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
   1. Minimum Service Temperature: Minus 40 degrees F.
   2. Maximum Service Temperature: 220 degrees F.
   3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETING AND ACCESSORIES

A. Aluminum Jacket:

1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
2. Thickness: 0.016 inch sheet.
3. Finish: Embossed.
4. Joining: Longitudinal slip joints and 2 inch laps.
5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

B. Reinforced Tape:
1. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723 or ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
4. Finish: Match insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature; insulate entire system.

G. Inserts and Shields:
1. Shields: Galvanized steel between hangers and inserts.
2. Insert Location: Between support shield and equipment and under the finish jacket.
3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Finish insulation at supports, protrusions, and interruptions.

I. Exterior Applications:
1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
2. Cover with aluminum.

J. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A. Cooling Systems: 1-1/2 inch elastomeric foam insulation. For exterior applications, 2 inch insulation.
   1. Pump Bodies
   2. Air Separators
   3. Expansion Tanks
   4. Chiller Cold Surfaces (Not Factory Insulated)
   5. Equipment Exposed to Freezing with Heat Tracing

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Flexible removable and reusable blanket insulation.

C. Jacketing and accessories.

D. Engineered wall outlet seals and refrigerant piping insulation protection.

1.02 REFERENCE STANDARDS

A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2021a.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019, with Editorial Revision (2023).

D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement 2007 (Reapproved 2019).

E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation 2017 (Reapproved 2023).

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2023).

H. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation 2019.

I. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation 2023.

J. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation 2021.

K. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).

L. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 2008 (Reapproved 2019).

M. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics 2016 (Reapproved 2023).

N. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics 2017 (Reapproved 2023).

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2023c.

P. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022a, with Editorial Revision (2023).

Q. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).

R. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2023).

S. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

T. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015, with Editorial Revision (2021).

U. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials 2013 (Reapproved 2021).

V. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth 2016b.

W. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 HYDROUS CALCIUM SILICATE

A. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
   1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 1200 degrees F.
   3. Density: 15 pcf.

B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

C. Insulating Cement: ASTM C449.

2.03 RIGID, CELLULAR PHENOLIC

A. Manufacturers:
   1. Dyplast Products, LLC: www.dyplastproducts.com/#sle.
   2. ITW Insulation Systems: www.itwinsulation.com/#sle.
   3. Polyguard Products: www.polyguardproducts.com.com/#sle.

B. Insulation: ASTM C1126, Type III, Grade 1.
   1. Nominal Density: 3.75 pcf.
   2. Preliminary Initial Minimum K Value: 0.145 at 50 degrees F based on density of 2.5 pcf.
   3. Maximum Service Temperature: 248 degrees F.
   4. Minimum Service Temperature: Minus 292 degrees F.
   5. Minimum compressive strength as determined by ASTM D1621.
   6. Minimum tensile strength as determined by ASTM D1623.

2.04 JACKETING AND ACCESSORIES

A. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
   2. Thickness: 0.016 inch sheet.
   3. Type: Factory-applied, self-adhesive jacketing.
   4. Finish: Embossed.
   5. Joining: Longitudinal slip joints and 2 inch laps.
   6. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
   7. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

B. Reinforced Tape:
   1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
   2. Comply with UL 723, ASTM E84.
   3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
   4. Finish: Match insulation.

C. Plain Foil Tape:
   1. Aluminum foil with pressure-sensitive adhesive on paper release liner.

2.05 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION

A. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
   1. Wall Outlet Size, Stucco and Masonry Applications: 7-1/2 inch wide by 10 inch high.
      a. Elastomeric Sleeve Diameter: 1-11/16 inch.
   2. Outlet Cover Color: Gray.
   3. Water Penetration: Comply with ASTM E331.
   4. Air Leakage: Comply with ASTM E283.
   5. Air Permeance: Comply with ASTM E2178.

B. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
   1. PVC Insulation Cover Color: Black with full-length velcro fastener.
   2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
   3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
   4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
   5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.
   6. Tensile Strength After UV Exposure and Water Immersion: Comply with ASTM D412.

2.06 ACCESSORIES

A. General Requirements:
   1. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
   2. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
   3. Supply materials that are asbestos free.

B. Corrosion Inhibitors:
   1. Corrosion Control Gel:
      a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Where existing piping insulation is either removed or damaged during construction, it shall be reinsulated per these specifications.

D. Exposed Piping: Locate insulation and cover seams in least visible locations.

E. Where insulation thickness exceeds 3 inches, the insulation shall be two layers. Secure first layer before installing the next layer and stagger the joints.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

H. Install insulation with least number of joints practical.

I. Insulated Pipes Conveying Fluids Below Ambient Temperature:
   1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
   2. Insulation on all pipes or ducts conveying air or liquids below the ambient temperature is required to have a continuous vapor barrier. On all insulation with a vapor barrier, seal the joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with a vapor-barrier coating/mastic as specified in the individual insulation sections.
   3. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier coating/mastic.
   4. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   5. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. For hot piping conveying fluids over 120 degrees F, insulate flanges and unions at equipment.

K. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

L. Inserts and Shields:
   1. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   2. Insert location: Between support shield and piping and under the finish jacket.
   3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

M. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.

N. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

O. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

P. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

Q. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

R. All exposed piping surfaces, insulation, supports, etc., shall be painted with two coats of oil base paint. Color shall be selected by the Owner.

S. Insulation systems shall be installed per the applicable plate from the MICA manual 8th edition:
   1. Pre-formed Pipe Insulation Single Layer Construction: Plate 1-100
   2. Flexible Foam Insulation: Plate 1-200
   3. Field applied Metal Jacketing: Plate 1-400
   4. Non-metallic sealed jacketing systems: PVC, etc: Plate 1-510
   5. Split Ring Hangers: Plate 1-600
   6. Clevis Hanger with High Density Inserts: Plate 1-610
   7. Pre-Insulated Pipe Support, Standoff Clamp: Plate 1-640
   8. Vapor Stop (Dam) - Pipe: Plate 1-660
   9. Refrigerant and Low Temperature: Plate 1-801
   10. Traced Piping: Plate 1-900
   11. Pre-formed Elbow Insulation: Plate 2-100
   12. Mechanical Fitting Field Fabricated: Plate 2-116
   13. Pre-formed or Fabricated Tee Insulation: Plate 2-120
   14. Field or Factory-Fabricated Valve Insulation: Plate 2-130
   15. In-line Flange Insulation Built-up and Beveled: Plate 2-135
   16. Flexible Foam Fittings: 90s and 45s: Plate 2-200
   17. Flexible Foam Fittings, Ts: 2-220
   18. Flexible Foam Ts: Plate 2-225
   19. PVC/Insert Valve Insulation: Plate 2-530
   20. PVC/Insert Mechanical Coupling on In-line Flange: Plate 2-535
   21. Non-metallic Jackets: Fitting and Valve Insulation Sealed Jacketing Systems: Plate 2-536
   22. PVC End Cap Over Insulation: 2-540
   23. Vapor Stop (Dam) - Fittings: Plate 2-660
   24. Large Diameter Vessels Block and Blanket Insulation: Plate 4-100
   25. Small Diameter Vessels: Plate 4-120
   26. Large Diameter Horizontal Vessels: Plate 4-140
   27. Vessels, Flexible Foam Sheets: 4-200
   28. Flexible Foam for Low Temperature Equipment: 4-210
   29. Vapor Stop (Dam) - Equipment: 4-660

3.03 SCHEDULE

A. Chilled Water:
   1. All interior piping 1.5 inches and smaller shall have minimum 1.5 inch thick insulation.
   2. All interior piping 2.0 inches and larger shall have 2.0 inch thick insulation.
   3. Piping installed in Boiler, Chiller, Mechanical Rooms, and outside of the building shall have minimum 2.0 inch thick insulation. Insulation on all mezzanine and platform piping shall have minimum 2.0 inch thick insulation.
   4. Chilled water piping insulation shall be closed-cell rigid phenolic foam type.

END OF SECTION

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SECTION 23 09 13.13

BAS ACTUATORS AND OPERATORS

PART 1 PRODUCT

1.01 ACTUATORS

A. Manufacturers:
   1. Belimo
   2. Honeywell
   3. Johnson
   4. Siemens
   5. Schneider
   6. Or Approved Equal

B. For dampers, the actuators used shall be provided from a single manufacturer.

C. For valves, the actuators used shall be provided from a single manufacturer.

D. Actuators shall be provided from a manufacturer registered under ISO9001:2000.

E. Electronic Valve Actuators.
   1. Size for torque required for valve close off at 150% of total system (head) pressure for 2-way valves; and 100% of pressure differential across the valve or 100% of total system (pump) head differential pressure for 3-way valves.
   2. Coupling: Directly couple end mount to stem, shaft, or ISO-style direct-coupled mounting pad.
   3. Mounting: Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.
   4. Overload Protection: Electronic overload or digital rotation-sensing circuitry without the use of end switches to deactivate the actuator at the end of rotation.
   5. Fail-Safe Operation: Mechanical, spring-return mechanism. Internal chemical storage systems, capacitors, or other internal non-mechanical forms of fail-safe operation are not acceptable.
   6. Power Requirements: Maximum 10 VA at 24 VAC or 8 W at 24 VDC.
   7. Maximum 1 VA at 24 VAC or 1 W at 24 VDC.
   8. Temperature Rating: -22 to +122°F (-30 to +50°C)
   9. Housing: Minimum requirement NEMA type 2 / IP54 mounted in any orientation.
   10. Agency Listing: ISO 9001, UL, UL(C) and CSA C22.2 No. 24-93.

PART 3 EXECUTION

2.01 ACTUATORS

A. General: Mount actuators and adapters according to manufacturer's recommendations.

B. Valve Actuators.
   1. Connect actuators to valves with adapters approved by actuator manufacturer.

END OF SECTION

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SECTION 23 09 13.23

BAS SENSORS AND TRANSMITTERS

PART 1 PRODUCT

1.01 SENSORS AND DEVICES

A. Input/output sensors and devices shall be closely matched to the requirements of the BAS controller for accurate, responsive, noise-free signal input/output. Control input response shall be high sensitivity and matched to the loop gain requirements for precise and responsive control.

B. Sensors and transmitters shall be manually calibrated on site so that the wiring length does not detract from the sensor accuracy specified.

C. Provide guards (plastic or wire) for sensors, thermostats, and transmitters that are installed in public areas such as gymnasiums, classrooms, corridors, and vestibules.

D. Temperature sensors shall have the following characteristics:
   1. Sensors shall have +/- 1.0 °F accuracy between 32 °F and 212 °F.
   2. Space temperature sensors
      a. Shall consist of an element within a ventilated cover.
      b. Space sensors located in mechanical rooms and public shall contain a network jack, but shall have no ability to adjust temperature setpoint (Set Point Adjustment).
      c. Space sensors shall be provided in accordance with the drawings and specifications with the following options:
         1) Sensor complete with Network Jack
         2) Sensor complete with Network Jack, and Set Point Adjustment
         3) Sensor complete with Network Jack, and illuminated Override switch
         4) Sensor complete with Network Jack, Set Point Adjustment, and illuminated Override switch
         5) Sensor complete with Network Jack, Set Point Adjustment, illuminated Override switch and Fan Speed Selection.

E. RTD Transmitter
   1. Where reference is made on the drawings for a RTD transmitter, it shall be interpreted as follows:
   2. Transmitters shall meet at minimum the following requirements.
      a. Provide an RTD transmitter in configurations below meeting the following requirements:
         1) 100 ohm or 1000 ohm PT RTD
         2) 24V ac/dc power supply.
         3) 4-20 mA, 0-10Vdc or 0-5Vdc outputs compatible with BMS.
         4) Electronics accuracy of +/-0.1% of span.
         5) Operating temperature range of 32°F to 158°F. OSA only - operating temperature range of -40°F to 185°F.
         6) Optional LCD display

F. Temperature Sensor – Immersion - Thermo well Mounted
   1. Provide thermo well mounted temperature sensors as indicated within the Field termination schedules and/or control diagrams as follows.
   2. Temperature sensors shall meet, at minimum, the following requirements:

a. Rigid 0.25” stainless steel probe of length, which is, at minimum, 20% of the pipe width.
b. Thermistor or RTD Compatible with BMS sealed in probe with three-part moisture protection system.
c. BMS shall report the monitored temperature with an accuracy of 0.5°C (1.0°F).
d. ABS housing with conduit entrance. (Optional metal or weather proof available)
e. Provide Brass or Stainless steel thermo well (316 or 304).
f. Provide with thermal grease to aid temperature sensing.

G. Water Pressure Sensor
1. Provide water pressure sensors as indicated within the Field termination schedules and/or control diagrams. Pressure sensors shall meet the following requirements:
a. Operating range shall be suitable for the application. Select range such that it covers from zero pressure to twice the amount of pressure desired for control purposes or that could be encountered.
b. 4-20 mA output proportional to water pressure.
c. % accuracy of range.
d. Temperature range of -40°F to 260°F.
e. Over pressure input protection of a minimum two times rated input.
f. An optional ABS wiring housing is available for an interior application and weatherproof wiring housing is available for an exterior application.
g. 17-4PH stainless steel wetted parts.
h. Burst pressure of a minimum five times rated input.

H. Current Relay/Switch
1. Provide current sensing relays as indicated in the Field termination schedules and/or control diagrams. Current sensing relays shall meet, at minimum, the following specifications:
a. Rated for the applicable load.
b. The output relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
c. Current relay shall have input and output isolation via current transformer.
d. Current relay shall be self-powered with no insertion loss.
e. Relay shall be in a dustproof housing.
f. Accuracy to be <2% of full-scale max.
g. Temperature rating of 5°F to 140°F.
h. Whenever the status of a single speed motor is monitored it shall be done via a current sensing relay.
i. The BMS contractor shall provide current sensing relays at the MCC starters.
j. The BMS contractor shall provide the current sensing relays for motors with local starters and no MCC starter.

I. Current Sensor
1. Provide monitoring of the current as identified in Field termination sheets and/or control drawings. Current monitoring shall meet, at minimum, the following requirements:
a. 4-20 mA, 0-10 or 0-5 Vdc output proportional to current draw.
b. Reverse polarity protected and output limited.
c. 50/60 Hz operation.
d. Accuracy of better than 1%.

e. Operating temperature range of -20°F to 120°F.

PART 2 EXECUTION

2.01 INSTALLATION OF SENSORS

A. Install sensors according to manufacturer's recommendations.

B. Mount sensors rigidly and adequately for operating environment.

C. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.

D. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.

E. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat- conducting fluid in thermal wells.

END OF SECTION

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SECTION 23 09 13.33

BAS CONTROL VALVES

PART 1 PRODUCT

1.01 VALVES

A. Acceptable Manufacturers:
   1. Belimo
   2. Bell & Gossett
   3. Danfoss
   4. Griswold
   5. Siemens
   6. Or Approved Equal

B. Ball-style body automatic control valves shall adhere to the following:
   1. NPS 4 and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a Tefzel flow characterizing disc.
   2. Sizing:
      a. Two-Position: Line size or size using a pressure differential of 1 psi.
      b. 2-way Modulating: 5 psig or twice the load pressure drop, whichever is greater.
      c. 3-way Modulating: Twice the load pressure drop, but not more than 5 psig.
   3. Close-off Pressure Rating: 100 psi. [NPS 3/4” and Smaller for Terminal Units: 200 psi.]
   4. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory with a single screw on a four-way DIN mounting-base.
   5. All control ball valves shall feature characterized flow guides when used for modulating applications.

PART 2 EXECUTION

2.01 APPLICATIONS

A. Hydronic control valves 6" and smaller shall be ball-style.

B. Hydronic control valves 8" and larger shall be butterfly-style.

C. Valves 1" and smaller shall be mechanical pressure independent control valves.

D. Valves 1-1/4" and larger shall be electronic pressure independent control valves.

E. All VAV and other terminal unit control valve actuators shall be fully modulating and controlled by 0-10V or 4-20mA analog signal. Using floating type actuators with dual digital output for control will NOT be acceptable.

2.02 CO-ORDINATION

A. Coordinate delivery of control valves to site.

B. Clearly tag and mark valves for their purpose and location.

C. Supervise Mechanical Contractor in the installation of the control valves ensuring proper valve(s) are located and installed in proper location(s)

END OF SECTION

SECTION 23 09 34

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code) 1989 (Corrigendum 2019).

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

C. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).

D. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives 2020.

E. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems 2022.

F. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems 2021.

G. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems 2005.

H. NEMA MG 1 - Motors and Generators 2021.

I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.

J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.

L. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.

M. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2) Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
   2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
   3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.

4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of controllers and adjacent equipment with required clearances indicated.
2. Include wiring diagrams showing factory and field connections.

D. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

E. Maintenance Materials: Furnish following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Air Filters: Two of each different type.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.07 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.08 WARRANTY

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

B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.abb.com/#sle.

B. Danfoss.

C. Eaton.

D. Honeywell

E. Schneider.

F. Siemens.

G. Yaskawa.

H. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Variable-Frequency Motor Controller:
   1. Configuration: Packaged controller with across-the-line bypass.
   2. Rectifier/Converter: Diode-based, 6-pulse type.
   3. Control Method: Vector; open-loop, without feedback.
   4. Filtering: Provide input/line reactor and output/load reactor.

D. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.

E. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
   1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
   2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
   3. Motor nameplate data.
   4. Requirements for speed control range, speed regulation, and braking.
   5. Motor suitability for bypass starting method, where applicable.

F. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.

G. Operating Requirements:
   1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
   2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
   3. Efficiency: Minimum of 96 percent at full speed and load.
   4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
   5. Overload Rating:
      a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.

b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.

H. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.

I. Control System:
1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
3. Control Functions:
a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
2) Vector Control: Provide selectable autotuning function.
b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
c. Selectable braking control; DC injection or flux braking.
d. Adjustable minimum/maximum speed limits.
e. Adjustable pulse width modulation switching carrier frequency.
f. Adjustable motor slip compensation.
g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
h. Selectable frequency-skipping; minimum of three independently adjustable bands.
i. Automatic catching of rotating motor.
j. Safety Interlock: Provide permissive run safety interlock capability where indicated or required; upon activation of designated input, stop and prevent operation of motor; operational in both drive and bypass modes where applicable.
4. Status Indications:
a. Motor run/stop status.
b. Motor forward/reverse status.
c. Local/remote control status.
d. Output voltage.
e. Output current.
f. Output frequency.
g. DC bus voltage.
h. Motor speed.
i. Speed reference.
5. Protective Functions/Alarm Indications:
a. Overcurrent.
b. Motor overload.
c. Undervoltage.
d. Overvoltage.
e. Controller overtemperature.
f. Input/output phase loss.

g. Output short circuit protection.
h. Output ground fault protection.

6. Inputs:
   a. Digital Input(s): Three.
   b. Analog Input(s): Two.
7. Outputs:
   a. Analog Output(s): One.
   b. Relay Output(s): Two.
8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
9. Features:
   a. Password-protected security access.
   b. Event log.

J. Power Conditioning/Filtering:
   1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
   2. Reactor Impedance: 3 percent, unless otherwise indicated or required.

K. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
   1. Disconnects: Circuit breaker or disconnect switch type.
      a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
      b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
      c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   2. Provide door-mounted remote operator interface.

L. Service Conditions:
   1. Provide controllers and associated components suitable for operation under following service conditions without derating:
      a. Altitude: Less than 3,300 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.

M. Short Circuit Current Rating:
   1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as determined by short circuit study performed in accordance with Section 26 05 73.
   2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.

N. Conductor Terminations: Suitable for use with conductors to be installed.

O. Enclosures:
   1. Comply with NEMA ICS 6.
   2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
      a. Indoor Clean, Dry Locations: Type 1 or Type 12.
      b. Outdoor Locations: Type 3R or Type 4.
   3. Finish: Manufacturer's standard unless otherwise indicated.

4. Cooling: Forced air or natural convection as determined by manufacturer.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:
   1. Motor Circuit Protectors:
      a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of listed combination motor controller with overload protection; ratings, configurations, and features as indicated or as required.
      b. Provide field-adjustable magnetic instantaneous trip setting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of controllers are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to accept controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

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

B. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 23 05 29.

F. Install controllers plumb and level.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. Install field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1. Tests listed as optional are not required.

D. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.07 PROTECTION

A. Protect installed controllers from subsequent construction operations.

END OF SECTION

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SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Chilled water piping, above grade.

C. Pipe hangers and supports.

D. Unions, flanges, mechanical couplings, and dielectric connections.

E. Grooved fittings

F. Valves:

1.02 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2023.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2021.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.

E. ASME B31.9 - Building Services Piping 2020.

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

G. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service 2019a.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2023a.

I. ASTM A536 - Standard Specification for Ductile Iron Castings 1984, with Editorial Revision (2019).

J. ASTM B32 - Standard Specification for Solder Metal 2020.

K. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2022.

L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.

M. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992 (Reapproved 2022).

N. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.

O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020, with Errata (2023).

P. AWWA C606 - Grooved and Shouldered Joints 2022.

Q. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
   1. Include data on pipe materials, pipe fittings, valves, and accessories.
   2. Provide manufacturers catalog information.
   3. Indicate valve data and ratings.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

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

B. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints may be used in accessible locations only.
      a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
      b. Grooved mechanical connections and joints comply with AWWA C606.
         1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
         2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
      c. Use rigid joints unless otherwise indicated.
      d. Depending on pipe size, three or four flexible joints may be used in lieu of a flexible connector.
      e. Use Victaulic Style 107, W77 rigid joints or equivalent by Anvil-Gruvlok unless otherwise indicated.
      f. Three Victaulic Style 177, 77, W77 flexible couplings or equivalent by Anvil-Gruvlok may be used in lieu of a flexible connector for vibration attenuation and stress relief. Couplings shall be located within close proximity of the source of vibration in accordance with the manufacturer's design guidelines.
      g. Victaulic Style 177, 77, W77 flexible couplings or Style 155 expansion joint or equivalent by Anvil-Gruvlok may be used to accommodate expansion and contraction on distribution and riser piping with engineer's approval.
      h. Bolts and Nutes: Hot dipped galvanized or zinc-electroplated steel.
      i. When piping is field grooved, provide coupling manufacturer's field grooving tools. If grooving in a fabrication shop, the manufacturer's smart tools are recommended.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
   1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
   2. On discharge of condenser water pumps, use spring-loaded check valves.
   3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
   4. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

5. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
6. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

2.02 CHILLED WATER PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black; using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Threaded Joints: ASME B16.3, malleable iron fittings.
   3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22, solder wrought copper fittings.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
      b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2.03 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
   1. Cooper B-Line
   2. Anvil International
   3. PHD

B. All hangers, supports, and hardware shall have hot-dip galvanized finish complying with ASTM A123 or ASTM A153. Epoxy plated or coated hardware will NOT be accepted.

C. Comply with Federal Specification WW-H-171E & A-A-1192A.

D. Hangers shall be UL Listed and FM Approved.

E. Refer to the Structural Drawngs and Details for the limitations and applications of each type of hanger and weight when attaching to bar joists, trusses, or other building Structural elements. The Contractor shall be responsible for providing additional miscellaenous steel, unistrut, and other components to span multiple joists as required by the Structural Drawings to distribute concentrated loads.

F. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Pipe Hangers for Hot and Chilled Water 6" and smaller: Cooper B3100, Anvil Fig. 260, or equivalent.
   3. Hangers for Hot Pipe 8" and larger: Adjustable steel yoke, cast iron roll, double hanger. Cooper B3110, Anvil Fig. 181, or equivalent.
   4. Riser Clamps: Cooper B3373, Anvil Fig. 40, or equivalent.
   5. Beam Clamps: Cooper B3050, Anvil Fig. 134, or equivalent.
   6. Offset Clamps: Cooper B3148, Anvil Fig. 103, or equivalent.
   7. Ceiling Plate: Cooper B3199, Anvil Fig. 610, or equivalent.
   8. Wall Brackets: Cooper B3067, Anvil Fig. 199, or equivalent.
   9. Rod Ceiling Plate: Cooper, Anvil Fig. 610, or equivalent.

10. Concrete Inserts: Cooper B2500, Anvil Fig. 95 or equivalent.
11. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
12. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Cooper B3205, Anvil Fig. 146, or equivalent.

G. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

H. All hangers, rods, and other hardware shall be hot-dip galvanized, except where copper plated for copper piping.

I. Pipe Saddles:
1. Manufacturers
   a. Buckaroos
   b. GLT Products
   c. PHD
2. Length
   a. 12" for piping up to 4"
   b. 18" for 6"
   c. 24" for piping up to 14"
3. Comply with MSS SP-58
4. Galvanized G-90 finish

2.04 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:
1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. See Section 23 25 00 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Slope piping and arrange to drain at low points.

G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 05 16.

H. Unless otherwise indicated, horizontal piping may be installed level or with a pitch up at 1" per 40' in direction of flow. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe. Terminate vent valve within two feet above ceiling in accessible location.

I. Main branches and runouts to terminal equipment shall be made at top (first choice) or top 45 degree (second choice), with drain valves suitably located for complete system drainage and manual air vents located as per above.

J. Bottom connections to piping are not allowed under any circumstances, unless specifically approved by the Engineer on a case by case basis. If permitted by the Engineer, a line size Y-strainer with shutoff valve and blowdown valve shall be installed at branch connection.

K. Mitered elbows, welded branch connections, notched tees, and "orange peel" reducers are notallowed. Unless specifically indicated, reducing flanges and reducing bushing are not allowed.Reducing bushings may be used for air vents and instrumentation connections.

L. Contractor shall provide all manual air vents and drains (air vents at high points, drains at low points) in order to allow for appropriate air venting and to permit complete drainage of the entire system.

M. Cut threads so that no more than 3 threads remain exposed after joint is made. Apply thread sealants to cleaned male ends. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.

N. Install valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed.

O. Make connections to equipment installed by others where said equipment requires piping services indicated in this section.

P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

Q. Welded Joints:
   1. Use weld material diameter as procedurally required for type and thickness of work being done.
   2. Use sufficient argon pre-puge and argon post-purge for GTAW processes.
   3. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.
   4. Weld reinforcement shall not exceed limits established in ASME B31.1
   5. Brush each weld free of rust and paint with rust resistant product that matches surface color.

R. Grooved Joints:

1. Install in accordance with the manufacturer's latest published installation instructions.
2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
3. Pump drops shall be installed as a single manufactured assembly and should not be disassembled for any reason. Roll grooved ends of spool piece cut to length to connect drops to Victaulic Style 26, Vic-Header.
4. All installed grooved product installations shall be visually verified by confirming pad to pad contact with positive or neutral offset.
5. A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved end products. The representative shall periodically visit the jobsite and verify contractor is following best recommended practices in grooved product installation.

S. Inserts:
   1. Provide inserts for placement in concrete formwork.

T. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Support horizontal piping as scheduled.
   3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
   7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
   8. Provide copper plated hangers and supports for copper piping.

U. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 07 19.

V. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00 .

W. Install valves with stems upright or horizontal, not inverted.

3.03 PRESSURE TESTS

A. Piping pressure tests shall be required on all new piping.
   1. Where connecting to existing systems, segregate new piping from existing system and provide isolation valves as required for testing.

B. Coordinate pressure tests with the Engineer and Owner at least 72 hours in advance. Engineer, Owner, and CxA may choose to witness the pressure test. If Owner and Engineer decide not to witness a specific test, the Construction Manager/General Contractor shall witness the test and sign off.

C. Conduct pressure tests prior to flushing and cleaning of piping systems.

D. Pressure tests may be made of isolated portions of the piping systems to faciliate general progress of the installation. Changes made in the piping system shall require retesting of the affected portions.

E. No system or part of the system shall be insulated until it has been successfully tested. If required

F. All hydronic piping shall be hydrostatically tested to 150 psi for a period of four (4) hours minimum.
   1. Use ambient temperature water as a testing medium unless there is a risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used if approved by the Engineer.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Subject piping system to hydrostatic test pressure. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   4. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
   5. No pressure drop shall occur during test period.
   6. Prepare written report of testing.

G. Provide pumps, appropriately scaled gauges, calibrated instruments and test equipment, temporary piping, and personnel for tests. Remove all test equipment and drain pipes after completion of testing.

H. If piping system is drained after testing and left empty or untreated for more than 3 days, add Nalco 2572 or equivalent at recommended dosages for dry system lay-up.

3.04 FLUSHING AND CLEANING OF PIPING SYSTEMS

A. Notify Engineer and Owner/CxA at least four (4) days in advance. Do not flush any piping system or portion thereof without prior submission and approval of flushing and cleaning plan.

B. General:
   1. All hydronic piping systems shall be tested and flushed. All temporary equipment, utilities, and materials, including water, required to perform the tests and flushing shall be the responsibility of the contractor. Tests and flushes shall be witnessed by the Engineer or Owner's representative. The contractor shall perform pre-testing so that the Engineer may witness the final test and flush only. If more than one test and flush are required, contractor shall schedule these with the Engineer's site observation schedule. Submit contractor's testing and flushing plan, indicating how the system will be divided for flushing, chemicaltesting and flushing plan, indicating how the system will be divided for flushing, chemical injection points, temporary bypass piping, temporary drains, etc.
   2. Test fluid shall be clean water
   3. Flush fluid shall be clean water with listed cleaning chemicals
   4. Fill fluid shall be clean water

C. Flushing and Fill:
   1. Flush entire piping system until clean. Flush velocity shall be minimum of 5 fps through all sections of the system.

2. Contractor shall provide portable pumping apparatus. Provide temporary materials, valves, equipment, and infrastructure, required to create bypass(es) for a closed system to perform flush(es). Bypass permanent building pumps during flush. Remove any devices that could be clogged or damaged prior to flushing. Provide a grade 18-8 stainless steel screen with 3/16 inch diameter holes at 18 holes per square inch in system strainers. Install #100 mesh startup liner in system strainer with metal screen. Operate valves as necessary to ensure all sections of the system are flushed for the required time period.
3. Provide temporary piping to bypass coils, control valves, and other factory cleaned equipment, as wells as equipment subject to damage.
4. Dissolve the following chemicals in the system (listed in piunds per 1,000 gallons of system water):
    a. EDTA 40 lbs
    b. CITRIC ACID 35 LBS
    c. SURFACTANT 4 ounces product: Tritan DF-16 or equivalent low-foaming surfactant
5. After initial 12 hours of flushing, screens and strainers shall be pulled, checked, and cleaned.Flushing shall then continue for another 12 hours. At the end of 24 hours, if strainers are still showing debris, continue flushing for 6 additional hours. System shall be flushed for a minimum of 24 hours and up to 30 hours as required.
6. After completion of cleaning solution flushing, the system shall be completely drained to sanitary sewer. Flush with clean water. If the system cannot be drained completely, put a bleed on system and add clean water until system test at a pH of 6.8 to 7.4.
7. Remove all temporary materials and bypass piping.
8. Apply corrosion control chemicals with 2-3 days of flushing and cleaning procedure. Submit reports confirming concentration.
9. Retesting and flushing
    a. Any changes made to the piping systems after testing and/or flushing shall require retesting and flushing of the affected portions of the system. If any portion of the piping system is exposed to dirt or debris after the flush, it shall be re-flushed.
10. Contractor Certification
    a. Provide a letter to the Engineer and Owner certifying the tests and flushes were performed in accordance with the specifications, what the final results were, and what the intermediate results were. The contractor's representative shall sign and date. A copy shall be placed in the O&Ms.
11. The Engineer or Owner/CxA shall review the test and flushr results prior to opening a new portion of piping to a previously approved portion or an existing system. If the supporting documentation is not reviewed by the Engineer prior to opening, the entire system shall be flushed again.

3.05 CLOSEOUT

A. If grooved fittings are used on the project, Contractor shall turn over one (1) set of grooved coupling tools for each pipe size (or group of sizes) to the Owner at Substantial Completion.

B. If copper Press fittings are used on the project, Contractor shall turnover one (1) set of press tools for each pipe size (or sizes) used on the project.

C. Provide four (4) hours of Owner training on grooved couplings. Training to be provided by manufacturer's authorized representative.

D. Provide four (4) hours of Owner training on copper press fittings. Training to be provided by manufacturer's authorized representative.

END OF SECTION

SECTION 23 21 23.01

HYDRONIC PUMP PACKAGE WITH AIR ELIMINATION

PART 1 GENERAL

1.01 REFERENCE

A. Material and construction requirements of this section shall supersede other specification sections unless specifically noted otherwise.

B. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Appropriate identification (for the package and each individual item)
   2. Overall unit dimensions
   3. Shipping and operating weight of unit and/or sections
   4. Capacities/ratings
   5. Materials of construction
   6. Data sheets shall be included for each major component. Data sheets shall include: manufacturer's name, model number and additional physical data.
   7. Pressure drop calculations for all equipment and fittings in package
   8. Wiring diagrams and terminal points for control panels provided with units
   9. UL, ASME and ANSI certifications
   10. Manufacturer’s installation instructions
   11. All other appropriate data
   12. Hydronic package manufacturer’s local representative and phone number

B. 3D CAD Drawings shall consist of sections/elevations, and isometric views showing layouts and details of hydronic package base, assembled components, piping and pipe fittings, connection locations, electrical devices and wiring, supports, accessories and component manufacturer’s recommended maintenance clearances.

C. Manufacturer shall provide a copy of the final approved CAD drawings to the Designer for inclusion in the record documents.

1.03 DESIGN CRITERIA

A. Furnish pump package complete with pumps, motors, pump specialties, piping, valves, piping specialties, variable frequency drives, and single point power connection meeting the configuration shown on drawings, specified and scheduled. All unit components shall meet this specification and requirements of referenced sections.

B. Contractor shall immediately notify Designer of any change in size of the hydronic package dimensions from that shown on the contract drawings after Contracts are awarded. Additional costs due to these changes shall be responsibility of this Contractor.

C. Hydronic package shall be constructed as necessary to allow transport through the building. Contractor shall determine transport route and maximum section size with

Owner and Construction Manager prior to submitting shop drawings to determine critical dimensions. Contractor shall notify Manufacturer of transport constraints which may impact the design and/or construction of the package.

D. All system components shall have a minimum rating of 125 psig operating at 250°F, unless otherwise specified. All piping shall be subjected to a hydrostatic test (at 10% below relief valve setting) for two hours, after final assembly.

E. Hydronic packages shall be field insulated by others. Unit layout and configuration shall take into account insulation requirements for the project.

1.04 QUALITY ASSURANCE

A. The Manufacturer shall assume “Unit Responsibility” for the complete hydronic package. Unit Responsibility shall be defined as responsibility for the interface and successful operation of all components supplied by the Manufacturer. The Manufacturer shall assemble the package. The Manufacturer must be actively engaged in the design and fabrication of the packaged system being assembled.

B. The Manufacturer must have dedicated and qualified service/startup division for all components provided as part of the packaged systems.

C. The Manufacturer of the packaged system must be an authorized manufacturer’s representative or reseller for all major components of the packaged system.

D. The hydronic package shall be Underwriters Laboratories or other nationally recognized testing laboratory listed, certifying compliance with UL QCZJ and UL508A standards as a complete package. This third-party product safety certification shall apply to the complete package, including pumps, motors, controls, wiring, valves and fittings, and safety devices as assembled into a complete package.

E. The manufacturer shall have 10 years (minimum) documented experience in the design, fabrication, testing and startup/servicing of hydronic package systems.

F. ASME Section IX certified welders shall perform all welding of the piping.

G. The manufacturer shall function test the completed packaged assembly at the factory prior to shipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Upon receipt of the equipment, the Contractor shall immediately verify that the equipment has not received damage during shipping and that all items listed on the bill of lading and the hydronic package Manufacturer shipping documents are included in the shipment. If damage has occurred or if items are missing, the Contractor must note this on the Manufacturer shipping list before accepting delivery of the equipment.

B. Storage and Protection: Store equipment and protect it from exposure to harmful weather conditions and at temperature conditions as recommended by Manufacturer. See the Manufacturer equipment storage instructions included in the Operations and Maintenance Manual, and raw material and component manufacturer’s instructions and Operations and Maintenance Manuals.

C. The Manufacturer shall seal fluid and air openings prior to shipment. Blow all piping and equipment free of water. Piping and equipment damaged by freezing shall be replaced, not repaired.

D. The Manufacturer shall deliver products to site with protective coverings and factory installed lifting lugs.

1.06 WARRANTY AND SERVICE

A. The entire packaged assembly, inclusive of all components, shall be warranted by the Manufacturer against defects in workmanship and operation for a period of eighteen (18) months from date of shipment from its factory or one (1) year from date of installation, whichever occurs first.

B. The Manufacturer shall have a service/startup department that is available for technical support, warranty, and/or service questions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: HYFAB

B. Acceptable Manufacturers: EAS, Systecon

2.02 UNIT BASE

A. Unit base shall be fabricated of 6” structural steel channel around unit perimeter and all section splits with additional structural members to support installed equipment.

B. Weld steel solid at connection points to assure rigidity. Size perimeter steel to allow for rigging and handling.

C. Locate and size base cross supports to support components, piping, and accessories.

D. Each section shall be constructed with a minimum of four permanently welded lifting lugs attached to the perimeter base steel. Where permanent lifting lugs are impractical, provisions shall allow installation of removable lifting lugs. Permanent and removable lugs shall incorporate a means of attaching a cable or chain into each lug.

E. Base shall be split in maximum size pieces to allow for economical shipment to jobsite and placement within building. Provide bolting on splits for field joining.

F. Unit base shall be primed and finished with high quality alkyd industrial enamel. Color is to be Smoke Gray.

2.03 DISTRIBUTION PUMPS

A. Subject to compliance with requirements below, provide pumps as scheduled from one of the following manufacturers:
   1. Basis of design: Series e1510 Bell & Gossett, Xylem Brand
   2. Other pre-approved manufacturer

B. Motor(s) shall be of size, type, electrical characteristics and efficiency scheduled on the drawings. Motors for use with VFDs shall be “inverter ready.” Motors shall be non-overloading across entire curve.

C. Pump(s) shall be base mounted, flexibly coupled, single stage, end suction design with an integrally cast, foot mounted volute, allowing the impeller and bearing assembly to be removed without disturbing piping connections or moving the motor.

D. The pump casing shall be of Class 30 cast iron with integrally-cast pedestal support feet, suitable for 175 PSI working pressure. The pump volute shall be supplied with vent, drain, and gauge tappings.

E. The bearing assembly shall have a solid SAE1144 steel shaft. A stainless-steel shaft sleeve shall be employed to completely cover the wetted area under the seal.

F. The pump bearings shall be greaseable ball bearing type with provision for purging or flushing through the bearing surface and shall be greased while running by the installer after start-up.

G. The impeller shall be stainless steel, enclosed, single suction type, dynamically balanced, keyed to the shaft.

H. The allowable residual unbalance in the impeller rotating assembly shall conform to ANSI Grade G6.3.

I. The liquid cavity shall be sealed off by an internally flushed mechanical seal with ceramic seat of 99.5% pure alumina oxide and hardness of 68 Rockwell C, or a tensile strength of 300,000 PSI, and carbon seal ring, suitable for continuous operation at 225 degrees F. The seals and bearings shall be capable of being serviced without disconnecting the pump from piping or disturbing the volute or motor in order to maintain original alignment.

J. A flexible type, spacer design coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor. Packaged pumping modules with optional factory installed Adjustable Frequency Drives (VFDs) shall have couplers designed for variable speed operation. Pump and motor shall be rough aligned by module manufacturer before shipment. Final alignment will be made by contractor after package is set and anchored in place.

K. Coupler shall be shielded by an ANSI and OSHA approved coupler guard securely fastened to the base.

L. Pump shall be capable of withstanding a horizontal load of 0.5 G without adversely affecting pump operation.

2.04 PUMP SPECIALTY ACCESSORIES

A. Pump Discharge Valves
   1. Subject to compliance with requirements below, provide pump discharge valves for each base mounted pump from one of the following manufacturers:
      a. Basis of design: Bell & Gossett Triple Duty Valve, Xylem Brand
      b. Other pre-approved manufacturer
   2. Triple Duty Valve shall be a center-guided, non-slam, lift check valve fitted with a bronze seat, replaceable bronze disc with EPDM seat insert, stainless steel stem and chatter preventing stainless steel spring.
   3. Valve shall be designed to permit re-packing under full line pressure.
   4. Valve shall be rated to 175 PSIG and shall be flanged cast iron. Valve shall be rated for 250 degrees F.
   5. The valve shall be equipped with readout ports to facilitate differential pressure readings across the valve orifice. Pressure drop data for each valve shall be provided for each 10% of valve range
   6. The valve shall be sized as scheduled on the drawings. The size shall be such that the pressure drop at design flow is 5 feet or less.

B. Suction Diffuser
   1. Subject to compliance with the requirements below, provide a suction diffuser for each base mounted pump from one of the following manufacturers:
      a. Basis of design: Bell & Gossett Suction Diffuser Plus, Xylem Brand
      b. Other pre-approved manufacturer
   2. The suction diffuser body shall be made of either cast iron or ductile iron.
   3. The suction diffuser shall include a Flow Cone to eliminate recirculation and direct flow completely out of the body and into the pump suction.
   4. The suction diffuser shall include a full-length, 4-plane, removable straightening vane made of carbon steel.
   5. The suction diffuser shall include a full-length removable orifice cylinder with 3/16” perforations and 51% open area made of carbon steel.
   6. The orifice cylinder shall be covered by a removable full-length start-up strainer made of 16 mesh bronze wire.
   7. The suction diffuser shall be available with threaded, ANSI 150 flanged or grooved system connections.
   8. The suction diffuser shall have a maximum temperature rating of 250°F (121°C).
   9. The suction diffuser shall be supported with a fabricated foot.

C. Pump Gauges
   1. Each pump shall have a single pressure gauge piped across its suction and discharge. Gauges shall be mounted near the pumps and connected to the pump gauge ports with 0.25” O.D. nylon tubing. Tubing shall have a pressure rating of 400 psi. Tubing shall be routed from the pumps to the gauges in a neat and workmanlike manner. Tubing shall be free of joints and fittings, except at connection points. Each sensing line shall be equipped with isolation ball valve (gauge cocks not permitted), Provisions shall be made at the pump connections to allow (field) insulation without impeding access to valves or gauges.

2.05 AIR CONTROL AND ELIMINATION SYSTEM

A. Hydraulic and Air Control System
   1. Subject to compliance with requirements below, furnish a hydraulic and air control system with accessories as scheduled from one of the following manufacturers:
      a. Basis of design: Bell & Gossett, Xylem Brand Rolairtrol and B Series Bladder tank with Bell and Gossett air control specialties..
      b. Other pre-approved manufacturer

B. The air elimination system with system pressurization, relief, and make-up assembly shall consist of:
   1. One centrifugal air separator as scheduled on the drawings.
      a. The centrifugal air separator shall have flanged inlet and outlet connections tangential to the vessel shell. Vessels without tangential connections are not acceptable.
      b. Manufacturer shall furnish data sheet specifying air collection efficiency and pressure drop at rated flow.
      c. The air separator must be designed, constructed, and stamped for 125 psig @ 350°F in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. A Manufacturer’s Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME

Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.
   d. One High Capacity Automatic Air Elimination Vent shall be mounted on top air connection of the Air Separator.
   e. One blow-down valve shall be mounted on the bottom drain connection of the tangential air separator.
2. One (1) ASME bladder tank sized as scheduled on drawings.
3. The bladder tank shall be a pre-charged steel expansion tank with replaceable heavy-duty butyl rubber bladder. The tank shall have a 1 in. NPT system connection, 3/4 in. drain, and a .302-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements.
   a. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure. A Manufacturers' Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code shall be furnished for each air separator upon request.
4. One (1) factory packaged make-up assembly (MUA) consisting of:
   a. One (1), pressure reducing valve for system pressurization and water make-up.
   b. One (1) line sized bypass, with bypass valve and two isolation valves and unions to permit service of the pressure reducing valve.
   c. One (1) ASME relief valve.
   d. One (1) bladder tank isolation valve to be a lockable valve to prevent inadvertent isolation of bladder tank.
   e. One (1) connection to bladder tank with one Automatic Air Vent

2.06 WATER PIPING, PIPING SPECIALTIES AND VALVES

A. Welded, flanged and threaded
   1. Pipe, 2” and smaller, ASTM A53, Type E, Grade B, Schedule 40 steel pipe with ASTM A197 class 150, malleable-iron fittings and threaded joints.
   2. Pipe, 2.5”-12”, ASTM A53, Type E, Grade B, Schedule 40 (STD) steel pipe, ASTM A234 wrought-steel fittings, ASTM A105 forged-steel flanges and fittings, welded and flanged joints.
   3. Pipe, 14” and larger, ASTM A53, Type E, Grade B, standard weight (0.375” thick) steel pipe, ASTM A234 wrought-steel fittings, ASTM A105 forged-steel flanges and fittings, welded and flanged joints.
   4. Isolation valves, 2” and smaller, bronze choice ball valves.
   5. Isolation valves, 2.5” and larger, lug pattern, 150 psi or better, butterfly valves for water service. Lever operated to 6”, 8” and larger, gear operated.
   6. Strainers, 2” and smaller, cast iron, threaded, class 250.
   7. Strainers, 2.5” and larger, cast iron, flanged, class 125 or 250 to match connected equipment.
   8. Gaskets, compressed fiber.
   9. Flange bolts and nuts, grade 5.

B. Grooved and threaded
   1. Pipe, 2” and smaller, ASTM A53, Type E, Grade B, Schedule 40 steel pipe with ASTM A197, class 150 malleable-iron fittings and threaded joints.
   2. Pipe, 2.5”-12”, grooved joint construction, shall have square cut pipe ends rolled or cut grooved in accordance with manufacturer’s specifications. Grooving tools shall be Victaulic using roll sets or cut groovers compatible with the pipe material and wall thickness per Victaulic installation instructions.

3. Grooved pipe shall be assembled with Victaulic Style 07 or 107 (or approved equal) couplings with ductile-iron housing and EPDM gaskets of central-cavity-pressure-responsive design.
4. Gaskets shall be suitable for the intended service and shall be coated on the lips with a thin uniform coat of lubricant in accordance with the manufacturer's instructions.
5. The nuts shall be uniformly tightened until the housing pads are firmly together with metal to metal contact allowing visual inspection, or until properly tightened per manufacturer's specifications and instructions.
6. Grooved valves, strainers, check valves, suction diffusers and specialties may be utilized on hydronic system grooved piping:
    a. Victaulic Series 761 or approved equal butterfly valves
    b. Victaulic Series 726 or approved equal ball valves
    c. Victaulic Series 732 or approved equal wye strainers
    d. Victaulic, Series 716 or approved equal check valves
    e. Victaulic Series 731-D or approved equal suction diffusers, grooved piping

2.07 PUMPING SYSTEM CONTROLS

A. No differential pressure pumping controls shall be furnished by the package manufacturer. Controls shall be field installed (off the package) by the BAS contractor.

2.08 ELECTRICAL, CONTROL, AND COMMUNICATION

A. Connection shall be for electrical service as scheduled on the plans. Electrical equipment shall have a short circuit rating equal to or greater than the available fault current at the point of connection. Equipment shall be labeled with short circuit current rating. Where available fault current is not indicated elsewhere, provide 25 kAIC rating.

B. Wiring from the power distribution panel to each electrical disconnect shall be installed by a factory technician, utilizing liquid-tight metallic conduit and connectors.

C. Wiring from each electrical disconnect to its pump motor shall be installed by a factory technician, utilizing liquid-tight metallic conduit and connectors.

D. Low voltage wiring shall be exposed cable neatly routed to avoid mechanical damage.

2.09 PAINTING

A. Each factory assembled packaged system, including all major components, shall be thoroughly cleaned after fabrication is complete.

B. The entire package shall be primed after cleaning.

C. After cleaning and priming, the package shall be painted with high-quality machinery grade enamel. Color shall be Smoke Gray.

D. Nameplates of the components shall not be painted over.

PART 3 EXECUTION

3.01 INSTALLATION

A. Unit manufacturer shall provide and install all equipment within unit as specified including pumps, motors, piping, piping specialties, controls, electrical, and all equipment necessary to provide a complete functional hydronic package. Mechanical and electrical connections (i.e., piping and conduit) shall be available at the outside perimeter of the hydronic package so that appropriate Contractor may provide service to the hydronic package. Electrical wiring and control wiring shall terminate in junction boxes/enclosures on accessible side of unit.

B. The Contractor shall set in place and anchor the package module(s) in accordance with the written recommendations of the Manufacturer of the hydronic package. The package base shall be installed level and without stress.

C. The Contractor shall make all piping connections to the package's connections provided, all in accordance with the written recommendations of the Manufacturer of the hydronic package. Piping connections shall not allow piping stress to be transferred to the package during installation or operation.

D. Control wiring for remote mounted differential pressure switches, differential pressure transmitters, flow transmitters, start/stop commands, alarms etc. shall be the responsibility of others. All control wiring shall be performed per the current edition of the NEC (NFPA 70.)

3.02 START-UP

A. The Manufacturer or manufacturer's representative's factory trained personnel shall provide start-up of the package. This start-up shall include verification of proper installation, system initiation, adjustment and fine tuning. This jobsite visit shall occur only after all hook-ups, tie-ins, and terminations have been completed and signed-off on the Manufacturer's start-up request form.

B. Remove Suction Diffuser start-up strainer after system has been running for 48 hours.

3.03 CLEANING

A. The entire package shall be thoroughly cleaned after installation.

3.04 TRAINING

A. The Manufacturer or Manufacturer's Representative shall provide on-site training for Owner's personnel. This training shall fully cover maintenance and operation of all system components.

END OF SECTION

SECTION 23 25 00

HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).

B. By-pass (pot) feeder.

1.02 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory Current Edition.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

F. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Sufficient chemicals for treatment and testing during required maintenance period.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of experience and approved by manufacturer.

1.05 WATER ANALYSIS

A. Submit complete water analysis and results of performance test of each system signed by manufacturer's service representative.

B. Water analysis shall include the following:
   1. Hot Water and Chilled Water
      a. Hardness
      b. pH
      c. "M" alkalinity
      d. Inhibitor level
      e. Total dissolved solids
      f. Temperature

1.06 WATER QUALITY REQUIREMENTS

A. Minimum water quality requirements for closed hot and/or chilled water systems shall be as follows:

pH	8.0-9.0
TDS	< 500 ppm
Hardness as CaCO3 and Alkalinity	< 120 ppm
Chlorides	< 200 ppm
Suplhates	< 200 ppm
Iron	< 0.5 ppm
Dissolved Oxygen	< 0.1 ppm
Ryznar Index	> 6.0
Suspended solids	< 10 micron
Bacteria Counts	
a. Total aerobic bateria counts	< 100 cfu per mL
b. Total anaerobic bacteria counts	< 10 cfu per mL

1.07 DESIGN CRITERIA

A. Chemicals shall be suitable for pipe material, fluid medium, and inteded treatment.

B. Provide initial chemical treatment and equipment for all systems based on complete system fluid analysis including makeup water prior to installation.

C. Initial supply of chemicals for treatment of each system shall be sufficient for start up and testing period, for the time the systems are operated by the Contractor for temporary heating and cooling, and for one year after start-up of system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. AmSolv-Amrep, Inc: www.amsolv.com/#sle.

B. GE Water & Process Technologies: www.gewater.com/#sle.

C. Nalco, an Ecolab Company: www.nalco.com/#sle.

D. Aqua-Chem.

E. Aqualine.

F. ChemTreat.

G. Water Guard.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

D. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

2.03 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
   2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).

B. Closed System Treatment (Water):
   1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
   2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Conductivity enhancers; phosphates or phosphonates.

2.04 BY-PASS (POT) FEEDER

A. Manufacturers:
   1. Griswold Controls: www.griswoldcontrols.com/#sle.
   2. J. L. Wingert Company: www.jlwingert.com/#sle.
   3. Neptune, a brand of the Dover Company: www.neptune1.com/#sle.
   4. Advantage Controls.

B. 5 gal quick opening cap for working pressure of 175 psi.

C. Provide cartridge filter.

PART 3 EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.02 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.

B. Chilled Water Systems:
   1. Circulate for 48 hours, then drain systems as quickly as possible.
   2. Refill with clean water, circulate for 24 hours, then drain.
   3. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier and approval of Engineer and Owner.

D. Remove, clean, and replace strainer screens.

E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Contractor shall install a BYPASS pipe wherever needed between the hydronic return & supply lines to recirculate the entire system using the hydronic pumps installed. The diameter of this pipe shall be at least 1/3 of the diameter of the main hydronic lines. The contractor shall also remove or cap the temporary BYPASS to a permanent configuration when flushing is complete and approved water chemistry is achieved.

C. Contractor shall remove all strainer screens prior to flushing all systems, including mud from the dirt legs. Contractor shall clean and replace/reinstall all strainer screens after the final cleaning and flushing procedure has passed the final test criteria noted herein.

D. Complete circulation must be achieved during the cleaning procedure. The Contractor shall develop a plan to achieve a minimum velocity of three feet per second (3 ft/s) in the pipes to ensure the cleaning chemicals will work properly. If necessary, isolate parts of the piping system to attain at least (3 ft/s) in piping being flushed. All electric, pneumatic, and thermostatic operated valves shall be full open. All deadend runs shall be looped together with piping not less than one-third the size of the run.

3.04 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

C. Provide 3/4 inch water coupon rack around circulating pumps with space for 4 test specimens.

3.05 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
   1. Provide minimum of two hours of instruction for two people.
   2. Have operation and maintenance data prepared and available for review during training.
   3. Conduct training using actual equipment after treated system has been put into full operation.

B. Written completeness certification and applicable reports will be forwarded to the project Engineer prior to acceptance.

3.06 MAINTENANCE

A. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.

B. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.

C. Provide monthly technical service visits to perform field inspections and make water analysis on-site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

D. Provide laboratory and technical assistance services during this maintenance period.

E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

END OF SECTION

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SECTION 23 64 33

MODULAR WATER CHILLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged air-cooled water chiller.

1.02 REFERENCE STANDARDS

A. AHRI 550/590 (I-P) - Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle 2023.

B. AHRI 575 - Method of Measuring Machinery Sound Within an Equipment Space 2017.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems 2022, with Errata (2023).

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks 2020, with Errata (2023).

F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels 2023.

G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2019.

H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

I. UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate physical size, weight and location of major pieces of equipment to be installed. Notify Architect of any major deviations from the equipment originally specified prior to ordering equipment.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide rated capacities, weights, specialties and accessories, electrical requirements and wiring diagrams.

C. Manufacturer's Performance Data: Indicate energy input versus cooling load output from 0 to 100 percent of full load at specified and minimum condenser water temperature for water-cooled chillers and at specified and minimum outdoor air temperature for air-cooled chillers.

D. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

E. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories; include trouble-shooting guide.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written installation instructions for rigging, unloading, and transporting units.

B. Deliver units to the job site completely assembled and charged with refrigerant and oil by manufacturer.

1.06 WARRANTY

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

B. Manufacturer's Warranty: Provide minimum five year warranty to include coverage for materials and labor for compressor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. York.

B. LG

C. Carrier

D. Substitutions: See Section 01 60 00 - Product Requirements.
   1. The chilled water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.
   2. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to Architect that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute.
   3. If the related equipment must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment.

2.02 AIR-COOLED MODULAR WATER CHILLER CONSTRUCTION REQUIREMENTS

A. Factory assembled and tested package-module consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, water circuit isolation valves, starters, and microprocessor-based controls.
   1. Rating: AHRI 550/590 (I-P).
   2. Safety: UL 1995 and ASHRAE Std 15.
   3. Machinery Sound Testing: AHRI 575.
   4. Construction & Testing: ASME BPVC-VIII-1 if applicable for construction type.
   5. Energy Efficiency: ASHRAE Std 90.1.
   6. Enclosures:
      a. Frame: Heavy gauge steel with factory painted finish.
      b. Cabinet: Factory baked on enamel finish.
      c. Perform 500-hour minimum salt spray test in accordance with ASTM B117 for units exposed to outdoor conditions.

B. Hermetic Scroll Compressors:

1. Module: Fully hermetic with two, direct drive compressors, adequate valve types and specialties required for operation and servicing in accordance with manufacturer's recommendations.
2. Vibration Control: Factory installed internal rubber-in-shear isolators.
3. Lubrication System: Initial oil charge, oil pump, oil level sight glass, and oil charging valve.
4. Capacity Reduction System: Compressor staging with duty cycling based on run time.
5. Motors: UL 984, 3,600, suction gas-cooled, with overload protection; see Section 23 05 13.

C. Evaporator Side:
1. Brazed plate made of 316 stainless steel.
2. Working Pressure Rating, Refrigerant Side: 650 psi minimum.
3. Working Pressure Rating, Water Side: 285 psi minimum.
4. End Connections: Provide with flanged end connections.

D. Cold Surface Insulation:
1. Insulation is factory or field installed on evaporator, connections, and suction piping.
2. 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex II insulation with a maximum K factor of 0.28.

E. Provide factory installed vents and water drain connections on evaporator or piping.

F. Freeze Protection for Outdoor Locations: Provide thermostatically controlled electric heater to protect from freezing at ambient temperatures down to minus 20 degrees F.

G. Provide factory-installed manual isolation valves in supply and return piping with modulating valve for variable primary flow operation.

H. Air-Cooled Finned-Tube Condenser:
1. Mechanically bonded aluminum fins to copper tubing and protect with corrosion resistant materials or coatings.
2. Clean and leak test at minimum pressure of 650 psi.
3. Coil Guards: Provide corrosion proof, heavy gauge wire panels, factory installed. Protect condenser coil by enclosing with heavy plastic to prevent damage during shipping or rigging.
4. Fans and Motors:
   a. Vertical-Discharge Fans: Dynamically balance propeller, shrouded-axial, or airfoil type fans of reinforced polymer or glass fiber reinforced composite corrosion resistant construction equipped with sealed, permanently lubricated ball bearings.
   b. Discharge Fan Guards: Corrosion resistant, heavy gauge steel wire.
   c. Motors: Direct drive, totally enclosed for outdoor use with current overload protection.

I. Refrigeration Circuits:
1. Provide two independent refrigeration circuits with one compressor per circuit.
2. Provide liquid line shut-off valve, filter-drier, thermal expansion valve, refrigerant relief device, and compressor discharge check valve for each independent circuit.

J. Controls Package:
1. Unit Controls: Factory-supplied DDC:

a. Control-panel mounted with required input-output expansions, power supply, fused disconnect, hand switches, knobs, and accessories required to control chiller unit to manufacturer required sequences to meet intended use with listed performance.
b. Factory configured to interface prewired sensors, switches, and safeties with allowance to add up to four chiller valves and flow sensors.
c. Graphic-based touchscreen to include unit operation controls and user filter based interface for faults, alarms, performance, unit diagnostics, and data recording up to 12 months.
d. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
e. External Point Mapping: Provide mapping table for each parameter included in the local visual interface with software-toggle flag to allow reduced mapping of available points.
f. Isolation Valves: Field-installed, 2-position, butterfly type with position tracking; see Section 25 35 19.

2. Prewire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starting contactors, disconnect switches, power and control wiring. Provide controls, monitoring, programmable setpoints, alarms, and BAS as defined below:
   a. Automatic Adjustable Operating Controls:
      1) Temperature of chilled water leaving chiller.
      2) Number of compressor circuits required to operate based on setpoints and system load.
      3) Compressor short-cycling prevention.
      4) Lead/lag operation for compressors. New lead compressor selected every 24 hours to equalize run time.
      5) Automatic reset on power source failure.
      6) Load limiting.
   b. Normal Operation Monitoring and Open Coverless Displays:
      1) Hours of operation.
      2) Suction and discharge refrigerant pressures.
      3) Automatic diagnostics.
      4) Number of starts.
      5) On/off compressor status.
      6) Entering and leaving chilled water temperatures.
      7) Status of operation.
      8) Compressor winding temperature.
      9) Suction temperature.
      10) Oil pressure.
   c. Setpoints:
      1) Leaving chilled water temperature.
      2) Date/time.
   d. Automatic Chiller Shut-Down Safety Controls and Alarm:
      1) Automatic Reset:
         (a) Chilled water flow interlock.
         (b) Voltage protection (over/under).
         (c) Phase reversal protection.
      2) Manual Reset:
         (a) Low suction pressure.
         (b) High motor winding temperature.
         (c) Low chilled water temperature.

(d) Low chilled water flow.
(e) High condenser refrigerant discharge pressure.
(f) Motor current overload and phase loss.
(g) Low oil flow.

3) Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
4) Minimum Data Transmission to BAS:
(a) All system operating conditions.
(b) Capacity control information.
(c) Safety shutdown conditions.
5) Minimum Operating Commands from BAS:
(a) Remote unit start/stop.
(b) Remote chilled water reset.

K. Electrical Characteristics (Single Point Power Connection):
1. Electrical: NEMA 250 or UL 1995 as applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Align chiller package on steel or concrete foundations.

C. Install units on vibration isolators, see Section 23 05 48.

D. Connect to electrical service.

E. Connect to chilled water piping.

F. Arrange piping for easy dismantling to permit tube cleaning and removal.

3.02 MANUFACTURER'S FIELD SERVICES

A. Perform factory startup of the chiller by factory trained and authorized servicing technicians confirming equipment has been correctly installed prior to equipment becoming operational and covered under the manufacturer's warranty.

B. Supply initial charge of refrigerant and oil if not completely factory charged.

C. Demonstrate system operations and verify specified performance.

3.03 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.04 CLOSEOUT ACTIVITIES

A. See Section 01 78 00 - Closeout Submittals for closeout submittals.

B. See Section 01 79 00 - Demonstration and Training for additional requirements.

C. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Location: At project site.

3.05 MAINTENANCE

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

END OF SECTION

SECTION 26 05 00.01

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. The electrical work includes the furnishing of all labor, materials, accessories, and equipment required to install a complete and fully operational electrical system as shown, specified and/or reasonably implied for a complete project.

1.02 RELATED DOCUMENTS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. ANSI/NFPA 70.

1.03 COORDINATION

A. The Electrical Contractor shall coordinate his work with the other contractors in accordance with provisions of Division 1.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with NECA Standard of Installation.

1.05 FEES, PERMITS, AND INSPECTIONS

A. Electrical Contractor shall obtain permits and arrange all inspections necessary for the installation of his work in accordance with General Conditions and furnish the Architect with certificates of inspection from all authorities having jurisdiction.

B. Inspections and tests shall be made upon formal written notice to the Architect from the Contractor sufficiently in advance to allow representatives of the Architect and Owner to be present for each test.

C. No construction shall be covered up or concealed until it has been inspected or approved. The Contractor shall furnish all material, labor, fuel, equipment and apparatus, and bear all expenses of such tests as are hereinafter specified for the work.

D. Final inspection and tests shall be made in the presence of the Architect and representatives of the Owner. The tests shall be made under conditions simulating as nearly as practicable those which will be obtained in operation and shall show conclusively that the requirements of the specifications have been fulfilled. Prior to receiving final payment, the Contractor shall, in accordance with Division 1, furnish to the Architect a certificate of inspection signed by the Electrical Inspector having jurisdiction.

1.06 REGULATORY REQUIREMENTS

A. Conform to the North Carolina State Building Code.

B. Conform to requirements of ANSI/NFPA 70.

C. Conform to requirements of ANSI/IEEE C2 where applicable.

D. Furnish products listed and classified by Underwriters Laboratories, Inc. or other North Carolina recognized third party testing agency.

1.07 QUALIFICATIONS

A. Manufacturer: Furnish products of manufactures listed or, where substitutions are allowed, furnish products of a company specializing in manufacturing products specified with minimum of three years experience.

B. Installation: Equipment and systems installers shall have a minimum of 5 years experience in installation of systems similar to those on this project unless indicated otherwise.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 1.

1.09 ALLOWANCES

A. Refer to provisions of Section 012100 - Allowances.

1.10 UNIT PRICES

A. Refer to provisions of Section 012200– Unit Prices.

1.11 ALTERNATES

A. Refer to provisions of Section 012300 - Alternates.

1.12 SEQUENCING AND SCHEDULING

A. Construct work in sequence under provisions of Division 1.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Three (3) complete sets of operating and maintenance manuals shall be submitted to the Owner through the Architect/Engineer two (2) weeks prior to the pre-final inspection date.

B. The O&M manuals shall be installed in a 3-ring heavy back note book with the name of the building and the words "Operation and Maintenance Manuals" on the cover and spine. The manuals shall contain the following items as a minimum:
   1. Index and page numbers.
   2. Certificate of substantial completion.
   3. All warranties.
   4. List of all subcontractors and suppliers with names, addresses and phone numbers.
   5. Certified testing and balancing report.
   6. Complete start-up operation, and shut-down procedures for each system including sequence of events, locations of switches, emergency procedures and any other critical items.
   7. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
   8. Equipment summary showing all capacities and ratings. (HP, Tons, KW, Filter size, etc.)
   9. All submittal data and shop drawings.

10. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
11. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instruction.
12. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly; aligning and adjusting instructions.
13. Wiring and control diagrams.
14. Manufacturer's cuts, part numbers, and serial numbers.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIAL

A. Equipment and material of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

B. Equipment and material shall be new and shall bear the manufacturer's name or trade name.

2.02 DIMENSIONS

A. The Contractor shall be responsible for insuring that items of equipment furnished fit the space available. He shall make necessary field measure ments to ascertain space requirements, including those of connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications.

2.03 MANUFACTURER'S DIRECTIONS

A. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the contract documents and manufacturer's directions and shall obtain the Architect's written instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

2.04 EQUIPMENT ACCESSORIES

A. The Contractor shall provide all equipment, accessories, connections, and incidental items necessary to fully complete the work, ready for use, occupancy and operation by the Owner.

PART 3 EXECUTION

3.01 MATERIALS AND WORKMANSHIP

A. All materials and workmanship shall comply with all applicable codes, specifications, state and local ordinances, industry standards, and utility company regulations. At the completion of the work, fixtures, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

3.02 LOCATION OF CONDUIT, FIXTURES, EQUIPMENT AND APPURTENANCES

A. These locations shall be adjusted to accommodate the work to ductwork and equipment installed by other Contractors in mechanical equipment rooms and similar areas.

3.03 BUILDING AND FINISHES

A. Building and finishes shall be protected. The Contractor will be held responsible for damage incurred and shall repair all damage done.

3.04 SUPPORTS

A. The Contractor shall support plumb, rigid, and true to line all work and equipment installed under this contract. The Contractor shall thoroughly study project construction drawings, shop drawings, and catalog data to determine how equipment, accessories, fixtures, and related items are to be supported, mounted, or suspended. He shall provide all bolts, inserts, brackets, structural supports, and accessories for proper support whether or not shown on the drawings.

B. Sleeves, inserts and supports that may be required for the electrical work shall be furnished by the Electrical Contractor, and they shall be installed, except as otherwise specified, by the trade furnishing and installing the material in which they are to be located. Location of sleeves, inserts, and supports shall be directed by the Electrical Contractor who shall also insure that they are properly installed. Sleeves shall be neatly sawed, sheared, or cut with wheeled cutters. No flame cutting will be permitted.

C. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs as specified will be provided by the various trades in their respective materials, but the Electrical Contractor shall see that they are properly located and shall do any cutting and patching caused by the neglect to do so.

D. Where sleeves are omitted or not provided in proper location through a concrete floor, the new holes at the proper location shall be drilled with a diamond core drill after obtaining permission from the Architect. No chiseling or other rough cutting will be permitted. No part of the building may be broken out, cut, burned out, or permanently removed.

3.05 FIRESTOPPING

A. Firestopping of penetrations for electrical work shall be installed by Electrical Contractor.

B. The Electrical Contractor shall be responsible for firestopping all partitions, walls and floor penetration resulting from his work. Penetrations shall be firestopped to meet or exceed rating of wall or floor systems as required by code.

3.06 SERVICE DISCONNECT MARKING

A. Each service disconnecting means shall be marked "SERVICE DISCONNECT" with engraved plastic plates.

3.07 COORDINATION

A. All power wiring and associated conduit shall be provided to HVAC and Plumbing equipment by the Electrical Contractor. The HVAC and Plumbing Contractor shall furnish all motor starters, disconnect switches, and combination starters for

equipment furnished under their contract and turn them over to the Electrical Contractor for installation. All final power wiring connections to equipment shall be made by the Contractor furnishing the equipment from slack wire left by the Electrical Contractor. Refer to detail, Sheet E100, of the Contract Drawings for division responsibility regarding electrical requirements.

B. HVAC Contractor will provide all control wiring, in conduit, required to satisfactorily control all HVAC equipment; furnish and wire all control devices such as thermostats, switches, relays and any other devices necessary to control the HVAC equipment.

C. Duct mounted smoke detectors shall be furnished by the Electrical Contractor and installed in duct work by the HVAC Contractor. Wiring to the fire alarm system shall be provided by the Electrical Contractor. Detectors shall be installed in strict accordance with manufacturer's installation instructions and/or NFPA 72 (AHJ adopted version).

3.08 PAINTING

A. All field painting of electrical work, with exception of touch-up paint on factory finished equipment, shall be by the Electrical Contractor in accordance with the "Painting" section of these specifications. Any equipment which has its factory paint coat scratched or otherwise damaged shall be retouched with paint to match the finish coat by the Electrical Contractor, and shall be repainted if necessary. Cut ends of steel framing channel used for equipment support shall be painted with a compound providing equivalent protection to the factory provided finish.

3.09 TESTING

A. All test reports shall be typewritten and submitted in triplicate. Reports shall include: Item(s) tested, date of each test, name and signature of person(s) conducting test, and complete test results.

B. Provide testing on each product or system as hereinafter specified in individual sections, and/or as recommended by product manufacturer.

C. All test reports shall be submitted, reviewed, and approved prior to substantial completion.

3.10 CLEAN-UP

A. The Contractor shall clean equipment, fixtures, and wiring device covers with cleaning materials appropriate to the surface and material being cleaned. Bottoms of equipment enclosures shall be cleaned to remove metal filings and other debris. All debris and excess materials shall be removed from the work area. The Contractor shall remove from the site all debris, crating, temporary facilities, waste, tools, construction equipment, machinery, and surplus materials resulting from his work.

3.11 THERMAL SCANNING

A. The Contractor shall provide infrared scanning on operational switchboard, transformers, and transfer switches, as well as feeder terminations over with ratings over 60 amps. Tests to be conducted after equipment start-up and prior to substantial completion.

B. A report of the results shall be submitted to the Owner and Commissioning agent as well as included in O&M manual submittals.

END OF SECTION

SECTION 26 05 19.01

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Building wire and cable.

B. Wiring connectors and connections.

1.02 RELATED SECTIONS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. Section 260532 - Conduit.

C. Section 260533 - Boxes.

D. Section 260553 - Identification.

1.03 REFERENCES

A. ANSI/NFPA 70

1.04 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide for each wire and cable type.

C. Insulation Resistance Test Report.

D. Bolted Connections Torque Measurements.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record feeder sizes.

1.06 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper, expressed in American Wire Gage (AWG) and Thousand Circular Mils (kcmil).

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.07 COORDINATION

A. Determine required separation between cable and other work.

B. Determine routing to avoid interference with other work.

PART 2 PRODUCTS

2.01 BUILDING WIRE AND CABLE

A. Description: Single conductor insulated wire.

B. Conductor:
   1. Branch circuits: Copper.
   2. Feeders: Copper or aluminum as indicated on drawings
      a. Aluminum Conductors: Comply with NEMA WC 70/ICEA S-95-658

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THHN2/THWN.

2.02 CLASS 2 CONTROL CIRCUIT CONDUCTORS

A. Description: Solid or stranded, per system manufacturer's recommendations.

B. Conductor: Copper.

C. Insulation: Min. 150 volt 60°C.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Use solid conductor for feeders and branch circuits 10 AWG and smaller, unless otherwise indicated

C. Use stranded conductors for control circuits.

D. Use stranded conductors in liquid tight flex for final connection to motors.

E. Use conductor not smaller than 12 AWG for power and lighting circuits.

F. Use conductor not smaller than 22 AWG for control circuits.

G. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.

H. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 230 feet.

I. Pull all conductors into raceway at same time.

J. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

L. Clean conductor surfaces before installing lugs and connectors.

M. Make splices, taps, and terminations to carry full capacity of conductors with no perceptible temperature rise.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
   2. Verify termination provisions in panels are listed and sized for use with aluminum conductors where applicable.

N. Use split bolt connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

O. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

P. Home runs may be combined in one conduit when all connections are in accordance with NFPA 70 requirements and the maximum unbalance current in the neutral does not exceed the capacity of the conductor. When circuits serving electronic loads are combined, the neutral shall be sized to accommodate harmonic currents.

Q. All feeders and subfeeders shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C from front to rear, top to bottom, or left to right when facing equipment.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 260553.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Division 1.

B. Inspect wire for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values. Record torque measurements.

D. Verify continuity of each branch circuit conductor.

E. Perform insulation resistance test on wiring No. 6 AWG and larger using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms. Record test data and include in O&M Manuals.

END OF SECTION

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SECTION 26 05 26.01

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

1.02 REFERENCES

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. ANSI/NFPA 70.

1.03 GROUNDING ELECTRODE SYSTEM

A. Metal underground water pipe.

B. Rod electrode.

C. Metal frame of the building.

1.04 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data for grounding electrodes and connections.

C. Test Reports: Indicate overall resistance to ground.

D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual locations of grounding electrodes and ground rings.

PART 2 PRODUCTS

2.01 ROD ELECTRODE

A. Manufacturers:
   1. Carolina Galvanizing Corp.
   2. Blackburn
   3. Copperweld

B. Material: Copper-clad steel.

C. Diameter: 3/4 inch.

D. Length: 10 feet.

2.02 MECHANICAL CONNECTORS

A. Manufacturers:
   1. Ilsco
   2. O. Z. Gedney
   3. Thomas & Betts

B. Material: Bronze.

2.03 WIRE

A. Material: Copper.
   1. Wire #10 (AWG) and smaller shall be solid.
   2. Wire #8 (AWG) and larger shall be stranded.

B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

C. Insulation (Where applicable): Green THWN.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

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

B. Bond together the metal underground water pipe, metal frame of the building, and rod electrode with an unspliced copper grounding electrode conductor, bare or insulated (as indicated), of the size indicated.

C. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

D. Provide bonding to meet Regulatory Requirements.

E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

F. Isolated ground: Provide a separate insulated grounding conductor connected to the grounding terminal of an isolated ground receptacle and insulate from the receptacle mounting means. This grounding conductor may be installed through one or more panelboards without connection to the panelboard grounding terminal so as to terminate in the same building or structure directly at an equipment grounding conductor terminal of the applicable derived system or service.

3.03 EQUIPMENT AND CIRCUITS

A. Conduit Systems:
   1. Ground all metallic conduit systems.

2. Conduit provided for mechanical protection and containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.

B. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
   2. Provide lugs in each box and enclosure for ground wire termination.
   3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.
   4. Isolated ground bars for isolated ground system.

C. Motors and Starters:
   1. Provide lugs in motor terminal box and starter housing for ground wire termination.
   2. Make ground wire connections to ground bus in motor starters.

D. Lighting Fixtures:
   1. Shall be grounded.
   2. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit.

E. Electrical Appliance and Equipment:
   1. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

3.04 CONDUCTIVE PIPING

A. Bond all conductive piping systems in the building to the building system ground.

3.05 BUILDING STEEL

A. Bond structural steel framing system with #3/0 bare copper conductor when structure is not electrically continuous at rate walls and expansion joints.

3.06 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Use suitable test instrument to measure resistance to ground of system. Perform and document testing in accordance with test instrument manufacturer's recommendations using the fall- of-potential method. Submit report with close out documents.

END OF SECTION

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SECTION 26 05 29.01

SUPPORTING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Conduit and equipment supports.

B. Anchors and fasteners.

C. Bridle rings.

1.02 REFERENCES

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. ANSI/NFPA 70.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. Materials and Finishes: Provide adequate corrosion resistance. Steel materials used outside shall be galvanized or cadmium plated. Where materials are cut, welded, or scratched leaving an unprotected area, area shall be painted with cold galvanizing compound. If required, entire item shall be painted to avoid a "touched up" appearance.

B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

C. Anchors and Fasteners:
   1. Concrete Structural Elements: Use expansion anchors, powder actuated anchors, or preset inserts.
   2. Steel Structural Elements: Use beam clamps, spring steel clamps, or steel ramset fasteners.
   3. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
   4. Hollow Masonry and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
   5. Solid Masonry Walls: Use expansion anchors or preset inserts.
   6. Sheet Metal: Use sheet metal screws. Do not fasten any materials to sheet metal which the metal does not have the strength to support.
   7. Wood: Use wood screws.

2.02 BRIDLE RINGS

A. 4" steel threaded bridle rings. Caddy #4BRT64 or equal with matching fasteners.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

D. Obtain permission from Architect/Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

F. Install surface-mounted cabinets and panelboards with minimum of four anchors.

3.02 BRIDLE RINGS

A. Provide bridle rings for support of above ceiling voice, intercom, security and television cabling.

B. Install bridle rings three feet on center mounted approximately 6 inches above finished ceiling in all corridors.

C. Provide matching support fasteners.

END OF SECTION

SECTION 26 05 33.14

CONDUIT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal conduit.

B. Flexible metal conduit.

C. Liquidtight flexible metal conduit.

D. Electrical metallic tubing.

E. Nonmetal conduit.

F. Fittings and conduit bodies.

1.02 RELATED SECTIONS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. Section 07841 - Firestopping

C. Section 260533 - Boxes.

D. Section 260526 - Grounding and Bonding.

E. Section 260529- Supporting Devices.

F. Section 260553 - Electrical Identification.

1.03 REFERENCES

A. ANSI C80.1

B. ANSI C80.3

C. ANSI C80.5

D. ANSI/NEMA FB 1

E. ANSI/NFPA 70

F. NECA "Standard of Installation."

G. NEMA RN 1

H. NEMA TC 2

I. NEMA TC 3

1.04 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide for each type conduit.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual routing of conduits larger than 2 inches.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Division 1.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

1.08 PROJECT CONDITIONS

A. Verify routing and termination locations of conduit prior to rough-in.

B. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

C. Conduit shall be concealed in all areas except mechanical rooms.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Minimum Size: 3/4 inch unless otherwise specified.

B. Underground Installations:
   1. Use plastic coated conduit or thickwall nonmetallic conduit.
      a. Under Slab on Grade: Use plastic coated conduit, or thickwall nonmetallic conduit.
      b. Minimum Size: 3/4 inch.
      c. Service lateral and conduit under areas subject to vehicular traffic shall be installed in ductbanks.
      d. Transition from Underground to Above Grade: Use rigid steel or intermediate metal conduit elbow to turn up to above grade. Coat underground rigid steel or IMC conduit with asphaltum paint.

C. Wet and Damp Locations: Use rigid steel conduit, intermediate metal conduit, or thickwall nonmetallic conduit.
   1. Schedule 80 PVC conduit may be used exposed above 8’-0” in parking deck. Expansion fittings must be used to compensate for thermal expansion to accommodate 100 degree F temperature change.

D. Dry Locations:
   1. Concealed: Use rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.
   2. Exposed eight feet or below: Use rigid steel conduit or intermediate metal conduit except that EMT may be used where branch circuits connect to the top of a surface mounted panelboard below eight feet.

3. Exposed above eight feet and not subject to physical damage: Electrical Metallic Tubing.

2.02 METAL CONDUIT

A. Manufacturers:
   1. Allied Tube and Conduit.
   2. LTV Corp.
   3. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. Intermediate Metal Conduit (IMC): Rigid steel.

D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type material to match conduit. Split couplings are not acceptable.

2.03 FLEXIBLE METAL CONDUIT

A. Manufacturers:
   1. Alflex Corp.
   2. Carol Cable Co.
   3. Alliance Cable Corp.

B. Description: Interlocked steel construction.

C. Fittings: ANSI/NEMA FB 1. Connectors; insulated throat type.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:
   1. Alflex Corp.
   2. Carol Cable Co.
   3. Alliance Cable Corp.

B. Description: Interlocked steel construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1. Connectors; insulated throat type.

2.05 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube and Conduit.
   2. LTV Corp.
   3. Wheatland Tube Co.

B. Description: ANSI C80.3; galvanized tubing.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; die-cast compression type. Connectors; die-cast insulated throat type.

2.06 NONMETALLIC CONDUIT

A. Manufacturers:
   1. Carlon.
   2. Cantex Industries
   3. LCP Chemicals and Plastics, Inc.

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation."

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Provide suitable nylon pull string in each empty conduit except sleeves and nipples.

D. Use suitable plastic slip caps to protect installed conduit against entrance of dirt and moisture.

E. Ground and bond conduit under provisions of Section 26 05 26.

F. Identify conduit under provisions of Section 26 05 53.

G. Tubing shall not be used in concrete or underground.

H. Utilize liquid tight flexible metal conduit for connection to equipment.

I. Utilize flexible metal conduit for connection of light fixtures.

J. Underground conduits shall have routing accurately recorded on as-built drawings with location dimensions indicated from at least two permanent above ground structures. Depth from finished grade shall also be recorded.

K. Underground conduit larger than 1" shall be encased in 3" of concrete on all sides when not routed directly below building slab.

L. Light fixtures connections may be made with 1/2" flexible metal conduit.

3.02 CONDUIT SUPPORTS

A. Arrange supports to prevent misalignment during wiring installation.

B. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

C. Group related conduits; support using conduit rack. Construct rack using steel channel.

D. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.

E. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

F. Do not attach conduit to ceiling support wires.

G. Arrange conduit to maintain headroom and present neat appearance.

H. Conduit Supports:
   1. Rigid Steel, IMC, and EMT: Conduit or tubing shall be fastened in place on not more than 6 feet on center for up through one inch and 8 feet on center for sizes larger than one inch and shall be fastened within 3 feet of connection to outlet boxes, junction boxes, cabinets, or fittings.
   2. Nonmetallic Conduit: Fasten on not more than 3 feet on center for up through one inch, 5 feet on center for 1 1/4" through 2", and 6 feet on center for sizes larger than 2 inches. Fasten within 2 feet of connection to outlet boxes, junction

boxes, cabinets, or fittings.

3. Flexible Conduit: Fasten not more than 4 1/2 feet on center and within 12 inches of connections to outlet boxes, junction boxes, cabinets, or fittings.

3.03 ROUTING

A. Route exposed conduit parallel and perpendicular to walls.

B. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

C. Route conduit under slab on grade from point-to-point.

D. Maintain adequate clearance between conduit and piping.

E. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

F. Conduit wall penetrations shall be perpendicular to the plane of the wall.

G. Install conduit to preserve fire resistance rating of partitions, floors, and ceilings.

H. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

3.04 CONDUIT FITTINGS

A. Cut conduit square using saw or pipecutter; de-burr cut ends.

B. Bring conduit to shoulder of fittings; fasten securely.

C. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean with approved product before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

D. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

E. Install no more than equivalent of four 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.

F. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

G. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.

3.05 SURFACE RACEWAY

A. Mount surface raceway at 36" to center unless otherwise noted on drawings.

B. Power receptacles shall be installed and circuited as indicated on drawing.

C. Communications raceway shall be wired as shown, with communication cabling as indicated on drawings.

END OF SECTION

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SECTION 26 05 33.17

BOXES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling outlet boxes.

B. Pull and junction boxes.

1.02 RELATED SECTIONS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. Section 26 27 26 - Wiring Devices: Mounting heights of wiring device outlets.

C. Section 26 05 29 – Supporting Devices.

1.03 REFERENCES

A. ANSI/NEMA FB 1

B. ANSI/NEMA OS 1

C. ANSI/NEMA OS 2

D. ANSI/NFPA 70

E. NEMA 250

1.04 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide for each type of box.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agencies. Include instructions for preparation and installation of product.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual locations of all boxes and hand holes. Record mounting heights of outlet, pull, and junction boxes.

1.06 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.

B. Verify locations of floor boxes and outlets with other Contractors, Architect, and Owner's Representative prior to rough-in.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

PART 2 PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.

B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Provide threaded hubs.

D. Minimum outlet box size: 4" square x 1-1/2" deep.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.

B. Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface-mounted junction box.
   1. Material: Galvanized cast iron.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

C. Size: Minimum size as required by NFPA 70 or larger, as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with the NFPA 70 and other regulatory requirements.

B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire. The Electrical Contractor will furnish panels and install in accordance with Section 08305.

E. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other, plumb and level.

F. Use flush mounting outlet boxes in finished areas.

G. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic, fire, and smoke rated walls.

H. Use adjustable steel channel fasteners for hung ceiling outlet box.

I. Do not fasten boxes to ceiling support wires.

J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

K. Use gang box where more than one device is mounted together. Do not use sectional box.

L. Use gang box with plaster ring for single flush outlets.

M. Use cast outlet box where exposed below 8'-0", in exterior locations and wet locations.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Locate flush mounting box in masonry walls as they are erected and to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Finished plate shall cover the entire cut opening.

B. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.

C. Position outlet boxes to locate luminaries as shown on reflected ceiling plan.

3.03 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall or floor material.

B. Install knockout closure in unused box opening.

C. The Architect shall have the right to make slight changes in the position of outlets if the contractor is notified prior to rough-in of outlet.

END OF SECTION

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SECTION 26 05 53.01

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Wire color coding.

C. Underground warning tape.

1.02 RELATED SECTIONS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. Section 09900 - Painting.

1.03 REFERENCES

A. ANSI/NFPA 70.

PART 2 PRODUCTS

2.01 NAMEPLATES

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background. Edges shall be chamfered. Minimum size shall be 1 inch high by 2.5 inches wide.

B. Locations: Major items of electrical equipment including switchboards, motor control centers, panelboards, individual starters, safety switches, transformers and individual components of switchboards and motor control centers shall be marked with a nameplate to identify the equipment and the location of the supply side overcurrent protection device.

C. Letter Size:
1. Use 1/4 inch letters for identifying individual loads.
2. Use 1/2 inch letters for identifying equipment and grouped loads.

2.02 WIRE MARKERS

A. Manufacturers
1. Seton Name Plate Co.
2. Thomas & Betts
3. 3M Electrical Products Div.

B. Description: Tape type wire markers.

C. Locations: Each conductor at panelboard gutters, pull boxes, junction boxes and each load connection. Provide markers on each side of bundled conductors within an enclosure.

D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams furnished with equipment.

2.03 UNDERGROUND WARNING TAPE

A. Manufacturers:
1. Seton Name Plate Co.
2. Thomas & Betts
3. 3M Electrical Products Div.

B. Description: 4 inch wide plastic tape, magnetic detectable type, colored red with suitable warning legend describing buried electrical lines or orange describing buried telephone lines.

2.04 PLACARDS

A. Placards: Engraved three-layered laminated plastic, white letter on black background.

2.05 ARC FLASH HAZARD LABELING

A. All electrical equipment including but not limited to switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, etc, likely to require examination, adjusting, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential arc flash hazards. The label shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. Labels shall be similar to the following: “WARNING: ARC FLASH HAZARD. APPROPRIATE PPE REQUIRED BEYOND THIS POINT. FAILURE TO COMPLY CAN RESULT IN INJURY OR DEATH. REFER TO NFPA 70.”

2.06 IDENTIFICATION LABELS

A. Manufacturers:
1. W.H. Brady Company (Style A)
2. Thomas & Betts (Style A)

B. Laminated Tape
1. Non-conductive
2. Waterproof
3. Capable of withstanding continuous temperature of 235°F and intermittent tempuratures of 300°F.
4. Overcoating for protection against oil, solvents, chemicals, moisture, abrasion and dirt.

C. Heavy, thermo-resistant industrial grade adhesive, for adhesion of label to any surface without curling, peeling or falling off.

D. Machine printed.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 APPLICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using screws or rivets.

C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

D. Identify underground conduits using underground warning tape. Install one tape per trench at 6 inches below finished grade.

3.03 WIRE COLOR CODING

A. Color coding is required for all service, feeder, branch, control, and signalling circuit conductors. Color shall be green for grounding conductors. The color of the ungrounded and neutral conductors shall be as follows:

120/240 volt, single phase system	
Line 1	Black
Line 2	Red
Neutral	White
208Y/120 volt, three phase system	
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
480Y/277 volt, three phase system	
Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Gray

B. Conductors #8 (AWG) and smaller shall be factory color coded.

C. Conductors #6 (AWG) and larger may be identified with plastic tape of the proper color.

3.04 BOX IDENTIFICATION

A. All cover plates of junction boxes for power wiring shall be legibly marked with permanent marker to clearly indicate panelboard origin and circuit number of all phase conductors enclosed.

B. All cover plates of junction boxes for fire alarm system wiring shall be painted red and shall be legibly marked with permanent marker to clearly indicate zone or signal circuit to which enclosed conductors are connected.

3.05 PAINTING

A. Painting for identification of products installed under the Electrical Contract shall be provided by the Electrical Contractor under provisions of Section 09900. Touch up painting required on factory finished equipment shall be by Contractor who furnishes

the equipment.

3.06 LIGHT SWITCHES AND RECEPTACLE CIRCUIT IDENTIFICATION

A. Provide identification labels on faceplates to indicate panelboard and circuit number from which they are served. Labels shall have black letters on clear tape.

END OF SECTION

SECTION 26 28 16.17

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fusible switches.

B. Nonfusible switches.

C. Fuses.

1.02 RELATED SECTIONS

A. General provisions specifically applicable to Division 26 Sections, in addition to Division 1 - General Requirements.

B. Section 260553 - Electrical Identification.

1.03 REFERENCES

A. NEMA KS 1.

B. NFPA 70.

C. UL 198E.

1.04 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide switch ratings and enclosure dimensions.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual switch locations; indicate actual ratings.

1.06 EXTRA MATERIALS

A. Furnish under provisions of Division 1.

B. Provide three of each size and type fuse installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric.

B. Siemens Energy & Automation Inc.

C. Cutler-Hammer.

D. GE/ABB.

2.02 ENCLOSED SWITCHES

A. Fusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position except by operating a permissive release device. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position except by operating a permissive release device. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R or 4X, as indicated.

2.03 FUSES

A. Manufacturers:
   1. Bussmann
   2. Gould Shawmut
   3. Littlefuse

B. Description: Current limiting, one-time fuse, UL 198E, Class RK 1, 250 volt or 600 volt as applicable. Use time delay fuses for motor loads.

C. Interrupting Rating: 200,000 rms amperes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install disconnect switches where indicated.

B. Install fuses in fusible disconnect switches.

C. Provide ½" stand-off mounting hardware for all exterior disconnects mounted on concrete or masonry surfaces.

D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

E. Provide engraved plastic nameplates under provisions of Section 26 05 53.

F. Mounting Height: 5 ft. to operating handle unless otherwise indicated.

END OF SECTION