BUNCOMBE COUNTY SCHOOLS
PREPARING STUDENTS FOR THEIR TOMORROW

Tony Baldwin, Ed.D., Superintendent

175 Bingham Rd., Asheville, NC 28806
P: 828-255-5921 | F: 828-255-5923
buncombeschools.org

PROJECT MANUAL FOR
LEICESTER ELEMENTARY SCHOOL HVAC UPGRADES

RFP# 1-20

175 BINGHAM ROAD, ASHEVILLE, NORTH CAROLINA 28806

BID DATE: WEDNESDAY, JANUARY 29, 2020 at 4:00 pm EST

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STATE OF NORTH CAROLINA/BUNCOMBE COUNTY SCHOOLS
REQUEST FOR PROPOSAL RFP# 1-20

PROJECT: LEICESTER ELEMENTARY SCHOOL HVAC UPGRADES

PROJECT DESIGNER: Gerald Isbouts, Project Manager

ISSUING AGENCY: Buncombe County Schools **ISSUE DATE: January 6, 2020**

Sealed proposals subject to the conditions made a part hereof will be received until **4:00 pm EST on Wednesday, January 29, 2020** for furnishing all labor, materials, equipment, and services incidental and implied, for completion of the project described herein.

PRE-BID MEETING: *A Pre-Bid meeting will be held on Thursday, January 9, 2020 at 9:00 am at Leicester Elementary School, 31 Gilbert Road, Leicester, NC 28748.* ***All visitors must report to the Main Office.***

SEND ALL PROPOSALS DIRECTLY TO THE ADDRESS AS SHOWN BELOW:

Buncombe County Schools, Purchasing Division
175 Bingham Road
Asheville, NC 28806
FAX: (828) 251-1730 (fax is not guaranteed, call to confirm 828-255-5890)

NOTE: Indicate firm name and RFP number on the front of each sealed proposal envelope or package, along with the date for receipt of proposals specified above.

Direct inquiries concerning this RFP to:	Gerald Isbouts, Project Manager	Phone: (828) 225-1108
	Jamie Messer, HVAC Supervisor	Phone: (828) 225-1105
	Tiffany McCants, Purchasing Officer	Phone: (828) 255-5890

THE PROCUREMENT PROCESS

The following is a general description of the process by which a firm will be selected to provide services.

1. Request for Proposals (RFP) is issued to prospective contractors.

2. Proposals in one original will be received from each offeror in a sealed envelope or package. Each original shall be signed and dated by an official authorized to bind the firm. Unsigned proposals will not be considered.

3. All proposals must be received by the issuing agency no later than the date and time specified on the cover sheet of this RFP.

4. At that date and time the proposals from each responding firm will be opened. Interested parties are cautioned that these costs and their components are subject to further evaluation for completeness and correctness and therefore may not be an exact indicator of an offeror's pricing position. Proposals are confidential until such time that award has been made. Thereafter, the Purchasing Department will furnish a bid tab on the district's website.

5. Proposals will be evaluated according to completeness, content, experience with similar projects, ability of the offeror and its staff, and cost. Award of a contract to one offeror does not mean that the other proposals lacked merit, but that, all factors considered, the selected proposal was deemed most advantageous to Buncombe County Board of Education.

6. Offerors are cautioned that this is a request for offers, not a request to contract, and that Buncombe County Board of Education reserves the unqualified right to reject any and all offers when such rejection is deemed to be in its best interest.

(NOTE: THIS PAGE MUST BE FULLY EXECUTED AND RETURNED FOR CONSIDERATION OF PROPOSAL)

PROPOSAL FORM

LEICESTER ELEMENTARY SCHOOL HVAC UPGRADES
RFP# 1-20
DUE DATE: Wednesday, January 29, 2020 at 4:00 pm EST

By submitting this proposal, the potential contractor certifies the following:

** This proposal is signed by an authorized representative of the firm.

** It can obtain and submit to the Owner insurance certificates as required within 5 calendar days after notice of award.

** The cost and availability of all equipment, materials, and supplies associated with performing the services described herein have been determined and included in the proposed cost.

** All labor costs, direct and indirect, have been determined and included in the proposed cost.

** All taxes have been determined and included in the proposed cost.

** The offeror has attended the conference *(if applicable)* or conducted a site visit and is aware of prevailing conditions associated with performing these services.

** The potential contractor has read and understands the conditions set forth in this RFP and agrees to them with no exceptions.

Therefore, in compliance with this Request for Proposals, and subject to all conditions herein, the undersigned offers and agrees, if this proposal is accepted within 60 days (normally less) from the date of the opening, to furnish the subject services for a cost not to exceed:

BASE BID: Perform all work described on attached drawings "ME Bid Set BCS Leicester Elementary HVAC Upgrades 12-09-2019".

$ _____ dollars and _____/100 ($).

Alternate #1 (ADD): Provide and install two (2) water to heat pumps per drawing sheet M1.3.

$ _____ dollars and _____/100 ($).

Alternate #2: Provide a 4-year extended warranty on all parts and labor.

$ _____ dollars and _____/100 ($).

Addenda received: _____ (Yes/No)

OFFEROR: _____

ADDRESS: _____

CITY, STATE, ZIP: _____

TELEPHONE NUMBER: _____ FAX: _____

FED ID No: _____ Type & License #: _____

E-MAIL: _____ MBE Status: _____

Principal Place of Business if different from above (See General Information on Submitting Proposals, Item 18.):

_____

BY: (Signature) _____ TITLE: _____

DATE: _____ (Typed or printed name) _____

End of Proposal Form

GENERAL INFORMATION ON SUBMITTING PROPOSALS

1. **EXCEPTIONS:** All proposals are subject to the terms and conditions outlined herein. All responses shall be controlled by such terms and conditions and the submission of other terms and conditions, price lists, catalogs, and/or other documents as part of an offeror's response will be waived and have no effect either on this Request for Proposals or on any contract that may be awarded resulting from this solicitation. Offeror specifically agrees to the conditions set forth in the above paragraph by signature to the proposal.

78615644. **CERTIFICATION:** By executing the proposal, the signer certifies that this proposal is submitted competitively and without collusion (G.S. 143-54), that none of our officers, directors, or owners of an unincorporated business entity has been convicted of any violations of Chapter 78A of the General Statutes, the Securities Act of 1933, or the Securities Exchange Act of 1934 (G.S. 143-59.2), and that we are not an ineligible vendor as set forth in G.S. 143-59.1. False certification is a Class I felony.

78615645. **ORAL EXPLANATIONS:** The State/Buncombe County Schools shall not be bound by oral explanations or instructions given at any time during the competitive process or after award.

78615646. **REFERENCE TO OTHER DATA:** Only information which is received in response to this RFP will be evaluated; reference to information previously submitted shall not be evaluated.

78615647. **ELABORATE PROPOSALS:** Elaborate proposals in the form of brochures or other presentations beyond that necessary to present a complete and effective proposal are not desired.

In an effort to support the sustainability efforts of the State of North Carolina we solicit your cooperation in this effort.

It is desirable that all responses meet the following requirements:

- All copies are printed **double sided.**
- All submittals and copies are printed on **recycled paper with a minimum post-consumer content of 30%** and indicate this information accordingly on the response.
- Unless absolutely necessary, all proposals and copies should **minimize or eliminate use of non-recyclable or non re-usable materials** such as plastic report covers, plastic dividers, vinyl sleeves, and GBC binding. Three-ringed binders, glued materials, paper clips, and staples are acceptable.
- Materials should be submitted in a format which allows for **easy removal and recycling** of paper materials.

78615648. **COST FOR PROPOSAL PREPARATION:** Any costs incurred by offerors in preparing or submitting offers are the offerors' sole responsibility; the State of North Carolina/Buncombe County Schools will not reimburse any offeror for any costs incurred.

78615649. **TIME FOR ACCEPTANCE:** Each proposal shall state that it is a firm offer which may be accepted within a period of 45 days. Although the contract is expected to be awarded prior to that time, the 45-day period is requested to allow for unforeseen delays.

78615650. **TITLES:** Titles and headings in this RFP and any subsequent contract are for convenience only and shall have no binding force or effect.

78615651. **CONFIDENTIALITY OF PROPOSALS:** In submitting its proposal the offeror agrees not to discuss or otherwise reveal the contents of the proposal to any source outside of the using or issuing agency, government or private, until after the award of the contract. Offerors not in compliance with this provision may be disqualified, at the option of the State/Buncombe County Schools, from contract award. Only discussions authorized by the issuing agency are exempt from this provision.

78615652. **RIGHT TO SUBMITTED MATERIAL:** All responses, inquiries, or correspondence relating to or in reference to the RFP, and all other reports, charts, displays, schedules, exhibits, and other documentation submitted by the offerors shall become the property of the State/Buncombe County Schools when received.

78615653. **OFFEROR'S REPRESENTATIVE:** Each offeror shall submit with its proposal the name, address, and telephone number of the person(s) with authority to bind the firm and answer questions or provide clarification concerning the firm's proposal.

78615654. **SUBCONTRACTING:** Offerors may propose to subcontract portions of the work provided that their proposals clearly indicate what work they plan to subcontract and to whom and that all information required about the prime contractor is also included for each proposed subcontractor.

78615655. **PROPRIETARY INFORMATION:** Trade secrets or similar proprietary data which the offeror does not wish disclosed to other than personnel involved in the evaluation or contract administration will be kept confidential to the extent permitted by NCAC T01:05B.1501 and G.S. 132-1.3 if identified as follows: Each page shall be identified in boldface at the top and bottom as "CONFIDENTIAL". Any section of the proposal which is to remain confidential shall also be so marked in boldface on the title page of that section. Cost information may not be deemed confidential. In spite of what is labeled as confidential, the determination as to whether or not it is shall be determined by North Carolina law.

78615656. **HISTORICALLY UNDERUTILIZED BUSINESSES:** Pursuant to General Statute 143-48 and Executive Order #150, Buncombe County Schools invites and encourages participation in this procurement process by businesses owned by minorities, women, disabled, disabled business enterprises and non-profit work centers for the blind and severely disabled.

The Contractor agrees in particular to maintain open hiring and employment practices and to receive applications for employment in compliance with all requirements of applicable federal, state and local laws and regulations issued pursuant thereto relating to nondiscriminatory hiring and employment practices. Each Prime Contractor shall undertake an affirmative action program to ensure that no person shall be excluded from participation in any employment activities because of age, sex, race, religion, color, national origin or handicap.

78615657. **PROTEST PROCEDURES**: If an offeror wants to protest a contract awarded pursuant to this solicitation, they must submit a written request to the Purchasing Officer, Buncombe County Schools, 175 Bingham Road, or PO Box 16771, Asheville, NC 28806. This request must be received by the Purchasing Division within thirty (30) consecutive calendar days from the date of the contract award and must contain specific sound reasons and any supporting documentation for the protest. NOTE: Contract award notices are sent only to those actually awarded contracts, and not to every person or firm responding to this solicitation. Contract status and award notices are available through the purchasing division or the project designer with contact information as shown on the first page of this solicitation. Offerors may call to obtain a verbal status of contract award. All protests will be handled pursuant to the North Carolina Administrative Code, Title 1, Department of Administration, Chapter 5, Purchase and Contract, Section 5B.1519.

16. **TABULATIONS:** Offerors may visit the Buncombe County Schools website for bid tab details at www.buncombeschools.org/purchasing.

17. **VENDOR REGISTRATION AND SOLICITATION NOTIFICATION SYSTEM:** Vendor Link NC allows vendors to electronically register free with the State to receive electronic notification of current procurement opportunities for goods and services available on the Interactive Purchasing System. Online registration and other purchasing information are available on the Internet web site: http://www.state.nc.us/pandc/.

18. **RECIPROCAL PREFERENCE:** G.S. 143-59 establishes a reciprocal preference law to discourage other states from applying in-state preferences against North Carolina's resident offerors. The "Principal Place of Business" is defined as the principal place from which the trade or business of the offeror is directed or managed.

NORTH CAROLINA GENERAL CONTRACT TERMS AND CONDITIONS
(Contractual and Consultant Services)

1. **GOVERNING LAW:** This contract is made under and shall be governed and construed in accordance with the laws of the State of North Carolina.

78615732. **SITUS:** The place of this contract, its situs and forum, shall be North Carolina, where all matters, whether sounding in contract or tort, relating to is validity, construction, interpretation and enforcement shall be determined

78615733. **INDEPENDENT CONTRACTOR:** The Contractor shall be considered to be an independent contractor and as such shall be wholly responsible for the work to be performed and for the supervision of its employees. The Contractor represents that it has, or will secure at its own expense, all personnel required in performing the services under this agreement. Such employees shall not be employees of or have any individual contractual relationship with the Agency.

78615734. **KEY PERSONNEL:** The Contractor shall not substitute key personnel assigned to the performance of this contract without prior written approval by the Agency's Contract Administrator. The individuals designated as key personnel for purposes of this contract are those specified in the Contractor's proposal.

78615735. **SUBCONTRACTING:** Work proposed to be performed under this contract by the Contractor or its employees shall not be subcontracted without prior written approval of the Agency's Contract Administrator/Project Designer. Acceptance of an offeror's proposal shall include any subcontractor(s) specified therein.

78615736. **PERFORMANCE AND DEFAULT:** If, through any cause, the Contractor shall fail to fulfill in timely and proper manner the obligations under this agreement, the Agency shall thereupon have the right to terminate this contract by giving written notice to the Contractor and specifying the effective date thereof. In that event, all finished or unfinished deliverable items under this contract prepared by the Contractor shall, at the option of the Agency, become its property, and the Contractor shall be entitled to receive just and equitable compensation for any satisfactory work completed on such materials. Notwithstanding, the Contractor shall not be relieved of liability to the Agency for damages sustained by the Agency by virtue of any breach of this agreement, and the Agency may withhold any payment due the Contractor for the purpose of setoff until such time as the exact amount of damages due the Agency from such breach can be determined.
In case of default by the Contractor, the State may procure the services from other sources and hold the Contractor responsible for any excess cost occasioned thereby. The State reserves the right to require performance bond or other acceptable alternative guarantees from successful offeror without expense to the State.

Upon the entering of a judgment of bankruptcy of insolvency by or against the Contractor, the Agency may terminate this contract for cause.

Neither party shall be deemed to be in default of its obligations hereunder if and so long as it is prevented from performing such obligations by any act of war, hostile foreign action, nuclear explosion, riot, strikes, civil insurrection, earthquake, hurricane, tornado, or other catastrophic natural event or act of God.

78615737. **TERMINATION:** The Agency may terminate this agreement at any time by *15 days'* notice in writing from the Agency to the Contractor. In that event, all finished or unfinished deliverable items prepared by the Contractor under this contract shall, at the option of the Agency, become its property. If the contract is terminated by the Agency as provided herein, the Contractor shall be paid for services satisfactorily completed, less payment or compensation previously made.

78615738. **AVAILABILITY OF FUNDS:** Any and all payments to the Contractor are dependent upon and subject to the availability of funds to the Agency for the purpose set forth in this agreement.

78615739. **CONFIDENTIALITY:** Any information, data, instruments, documents, studies or reports given to or prepared or assembled by the Contractor under this agreement shall be kept as confidential and not divulged or made available to any individual or organization without the prior written approval of the Agency.

78615740. **CARE OF PROPERTY:** The Contractor agrees that it shall be responsible for the proper custody and care of any property furnished it for use in connection with the performance of this contract or purchased by it for this contract and will reimburse the State for loss of damage of such property.

78615741. **COPYRIGHT:** No deliverable items produced in whole or in part under this agreement shall be the subject of an application for copyright by or on behalf of the Contractor.

78615742. **ACCESS TO PERSONS AND RECORDS:** The State Auditor shall have access to persons and records as a result of all contracts or grants entered into by State agencies or political subdivisions in accordance with General Statute 147-64.7.
The Contractor shall retain all records for a period of three years following completion of the contract.

78615743. **ASSIGNMENT:** No assignment of the Contractor's obligations nor the Contractor's right to receive payment hereunder shall be permitted. However, upon written request approved by the issuing purchasing authority, the State may:

a. Forward the contractor's payment check(s) directly to any person or entity designated by the Contractor, or

b. Include any person or entity designated by Contractor as a joint payee on the Contractor's payment check(s).

In no event shall such approval and action obligate the State to anyone other than the Contractor and the Contractor shall remain responsible for fulfillment of all contract obligations.

78615744. **COMPLIANCE WITH LAWS:** The Contractor shall comply with all laws, ordinances, codes, rules, regulations, and licensing requirements (permits) that are applicable to the conduct of its business, including those of federal, state, and local agencies having jurisdiction and/or authority.

78615745. **AFFIRMATIVE ACTION:** The Contractor shall take affirmative action in complying with all Federal and State requirements concerning fair employment and employment of people with disabilities and concerning the treatment of all employees without regard to discrimination by reason of race, color, religion, sex, national origin, or disability.

78615746. **INSURANCE:** During the term of the contract, the contractor at its sole cost and expense shall provide commercial insurance of such type and with such terms and limits as may be reasonably associated with the contract. As a minimum, the contractor shall provide and maintain the following coverage and limits:

a. Workers Compensation - The contractor shall provide and maintain Worker's Compensation Insurance, as required by the laws of North Carolina, as well as employer's liability coverage with minimum limits of $150,000.00, covering all of Contractor's employees who are engaged in any work under the contract. If any work is subcontracted, the contractor shall require the subcontractor to provide the same coverage for any of its employees engaged in any work under the contract.

b. Commercial General Liability - General Liability Coverage on a Comprehensive Broad Form on an occurrence basis in the minimum amount of $2,000,000.00 Combined Single Limit. (Defense cost shall be in excess of the limit of liability.

c. Automobile - Automobile Liability Insurance, to include liability coverage, covering all owned, hired and non-owned vehicles, used in connection with the contract. The minimum combined single limit shall be $500,000.00 bodily injury and property damage; $500,000.00 uninsured/underinsured motorist; and $100,000.00 medical payment.

Providing and maintaining adequate insurance coverage is a material obligation of the contractor and is of the essence of this contract. All such insurance shall meet all laws of the State of North Carolina. Such insurance coverage shall be obtained from companies that are authorized to provide such coverage and that are authorized by the Commissioner of Insurance to do business in North Carolina. The contractor shall at all times comply with the terms of such insurance policies, and all requirements of the insurer under any such insurance policies, except as they may conflict with existing North Carolina laws or this contract. The limits of coverage under each insurance policy maintained by the contractor shall not be interpreted as limiting the contractor's liability and obligations under the contract.

The Contractor shall furnish a Certificate of Insurance as proof of the above coverages. Certificate will contain provision that the insurance coverages cannot be canceled, reduced in amount or coverage eliminated without 30 days written notice to the Buncombe County Board of Education. Owner's Protective insurance must list the Buncombe County Board of Education as the Certificate Holder and as "additional insured" as it's interest may appear. Owner's approval of Certificate of Insurance does not decrease or relieve the contractor's responsibility for maintaining insurance coverage as required in this Request for Proposal.

78615747. **ADVERTISING:** Contractor agrees not to use the existence of this contract, the name of the agency, or the name of the State of North Carolina as part of any commercial advertising.

78615748. **ENTIRE AGREEMENT:** This contract and any documents incorporated specifically by reference represent the entire agreement between the parties and supersede all prior oral or written statements or agreements. This Request for Proposals, any addenda thereto, and the offeror's proposal are incorporated herein by reference as though set forth verbatim.

All promises, requirements, terms, conditions, provisions, representations, guarantees, and warranties contained herein shall survive the contract expiration or termination date unless specifically provided otherwise herein, or unless superseded by applicable Federal or State statutes of limitation.

78615749. **AMENDMENTS:** This contract may be amended only by written amendments duly executed by the Agency and the Contractor.

78615750. **TAXES:** G.S. 143-59.1 bars the Secretary of Administration from entering into contracts with vendors if the vendor or its affiliates meet one of the conditions of G. S. 105-164.8(b) and refuse to collect use tax on sales of tangible personal property to purchasers in North Carolina. Conditions under G. S. 105-164.8(b) include: (1) Maintenance of a retail establishment or office, (2) Presence of representatives in the State that solicit sales or transact business on behalf of the vendor and (3) Systematic exploitation of the market by media-assisted, media-facilitated, or media-solicited means. By execution of the bid document the vendor certifies that it and all of its affiliates, (if it has affiliates), collect(s) the appropriate taxes.

78615751. **GENERAL INDEMNITY:** The contractor shall hold and save the State/Buncombe County Schools, its officers, agents, and employees, harmless from liability of any kind, including all claims and losses, with the exception of consequential damages, accruing or resulting to any other person, firm, or corporation furnishing or supplying work, services, materials, or supplies in connection with the performance of this contract, and from any and all claims and losses accruing or resulting to any person, firm, or corporation that may be injured or damaged by the contractor in the performance of this contract and that are attributable to the negligence or intentionally tortious acts of the contractor provided that the contractor is notified in writing within 30 days that the State/Buncombe County Schools has knowledge of such claims. The contractor represents and warrants that it shall make no claim of any kind or nature against the State's agents who are involved in the delivery or processing of contractor goods to the State. The representation and warranty in the preceding sentence shall survive the termination or expiration of this contract.

CONTRACTOR'S SALES TAX REPORT
Buncombe County Schools

NC State and Local Sales Taxes Paid

CONTRACTOR: _____ **PO#/RFP# 1-20**_____

Address:_____ **For Period:** _____

Invoice Date	Invoice #	Type of Property	NC Tax 4.75%	County Tax 2.25%	Name of County
		TOTAL	**$**	**$**	

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure, and all of the required sales and use tax have been paid. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the _____ day of _____, 20____

_____
Signed

_____
Notary Public

My Commission Expires: _____

_____
Print or Type Name of Above & Title

Seal

NOTE:
This certified statement may be subject to audit.

The North Carolina General Assembly has amended the Statute to provide refunds of sales and use tax to local school units in accordance with the provisions of G.S. 105-164. 14(c) effective with tax paid on or after July 1, 1998.

These refunds are to include the "sales and use taxes paid by contractors on building materials, supplies, fixtures and equipment that become a part of or annexed to a building or structure that is owned or leased by the governmental entity and is being erected, altered or repaired for use by the governmental entity (G.S. 1O5-164.14)."

Sales and Use Tax Technical Bulletin Section 18-2F specifies: "To substantiate a refund claim for sales or use taxes paid on purchases of building materials, supplies. fixtures and equipment by its contractor, the claimant must secure from such contractor certified statements setting forth all of the following information:

a. the date the property was purchased;
b. the type of property purchased:
c. the project for which the property was used:
d. if the property was purchased in this State, the county in which it was purchased;
e. if the property was not purchased in this State, the county in which the property was used; and
f. the amount of sales and use taxes paid.

In the event the contractor makes several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices and the State and local sales and use taxes paid thereon. Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of sales and use tax paid thereon by the contractor. Similar certified statements by his subcontractors must be obtained by the general contractor and furnished to the claimant. Any local sales or use taxes must be shown separately from the State sales or use taxes. The contractor's statements must not contain sales or use taxes paid on purchases of tangible personal property purchased by such contractors for use in performing the contract which does not annex to, affix to or in some manner become a part of the building or structure that is owned or leased by a governmental agency and is being erected, altered or repaired for use by a governmental entity as defined by G.S. 105-164.14(c). Examples of property on which sales or use tax has been paid by the contractor and which shall not be included in the contractor's statement are scaffolding, forms for concrete, fuel for the operation of machinery and equipment, tools, repair parts and equipment rentals.

All information requested in these specifications and actual bids shall be entered on enclosed "Request for Proposal" All areas of this document must be completed in full, especially: (1) Name of Company, (2) By (signature), (3) Official Title, and (4) Quotation Date.

LEICESTER ELEMENTARY SCHOOL HVAC UPGRADES
RFP# 1-20

Project: Furnish all labor, materials, equipment and services, incidental and implied, for the installation of HVAC system upgrades.

Scope: Work shall consist of furnishing all labor, taxes, materials, equipment, services, permits and startup, incidental and implied, to install a complete working system as designed per the attached specifications.

Contractor's Responsibility: The Contractor shall be responsible for the construction site during the performance of the work. The Contractor shall be responsible for all damages to persons and property during the performance of work and shall further provide all necessary safety measures and shall fully comply with all federal state and local laws, building rules, and regulations to prevent accidents or injury to persons or property on or about the location of the work site. This is to include OSHA 1910, General Construction, or those regulations mandated by these specifications. Special attention shall be made to proper barricading of the work area.

Safety Regulations: The Contractor shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974 Federal Register) which is hereby incorporated in these specifications.

Codes: All work shall be performed in accordance with the specifications and shall comply with North Carolina Building Code, National Electrical Code Underwriters' Rules and Regulations and Federal, State and Local Regulations covering work of this nature. Whenever specifications are more than such laws, codes and regulations, the specifications shall hold. All equipment shall have U. L. labels attached.

Permits: The Contractor shall hold the appropriate license for work to be performed and shall secure all permits required for the job completion, obtain and deliver to Owner, all certification of inspection issued by the authorities having jurisdiction and roofing material manufacturer. Contractor is responsible for paying all costs associated with Buncombe County building permits. All final certificates must be delivered to owner prior to request for final payment.

Scheduling: The Contractor must submit a precise time schedule as to when specific work will occur in specific areas within the building. This will be used to coordinate the work with the occupants of the building. The maintenance supervisor, Project manager or Principal may alter the schedule at any time to maintain the work process within the facility. Work must be scheduled during hours that are acceptable to each school and the Buncombe County Board of Education shall not incur any additional cost due to scheduling.

All work must be scheduled to avoid conflict with classroom instruction time, Cafeteria operation times and must be completed no later than April 3, 2020 (end of first week of April). The Heating part of the project must be completed prior to October 1, 2020. *Complete* is defined as *the contractor has passed the final inspection and a "green tag" is issued by authorities having jurisdiction.* All permits and inspections will be the responsibility of the contractor, and copies of permits and final inspection will be submitted to Buncombe County Schools prior to final payment.

Workers on Job: All employees of the Contractor shall, while on Buncombe County Board of Education property, act in a professional and courteous manner. All workers shall be expected to wear long pants and shirts while on Board property. Also, all employees of the Contractor must "sign in" in the main office upon entering the facility and must "sign out" upon leaving the property. Any employee of the Contractor may be told to leave the property by either the Principal or the Electrical Supervisor, if they do not follow the above procedure. The employee shall be replaced with another at no additional cost to the Buncombe County Board of Education. Smoking or use of Tobacco products is prohibited on Buncombe County School's property.

In accordance with G.S. 14-208.18, all persons who (1) are required to register under the Sex Offender and Public Protection Program AND (2) have been convicted of certain sexually violent offenses or any offense where the victim was under the age of 16 years at the time of the offense are expressly forbidden to knowingly be present on any property owned or operated by the school system, including school buildings, athletic fields, playgrounds, parking lots, school buses, activity buses or other property of any kind for any reason, including attendance at sporting events or other school related functions, whether before, during or after school hours. It is the responsibility of the Contractor or vendor that their employees and sub-contractors are in accordance with G.S. 14-208.18.

E-Verify: Contractor shall comply with E-Verify, the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law and as in accordance with N.C.G.S. §64-25 et seq. In addition, to the best of Contractor's knowledge, any subcontractor employed by Contractor as a part of this contract shall be in compliance with the requirements of E-Verify and N.C.G.S. §64-25 et seq.

Iran Divestment Act: North Carolina Local Government Units may not enter into contracts with any entity or individual found on the State Treasurer's Iran Final Divestment List N.C.G.S. 143C-6A. By bidding on this project, the bidder certifies it is not listed on the Final Divestment List created by the State Treasurer.

Equipment and Tools: The Contractor shall not use equipment or tools that are owned by the Buncombe County Board of Education. Also, employees of the Buncombe County Board of Education shall not be utilized by the Contractor except for opening locked doors and giving directions.

Materials: All materials stored on site must be stored in a safe and secure manner that does not interfere with the school's daily operation. Buncombe County Board of Education is not responsible for any materials, equipment or tools lost or stolen from the site.

Clean Up: The area of work shall be cleaned daily so that the Buncombe County Board of Education shall not incur any additional costs to make the area suitable for the work process. Also, the Contractor shall utilize no trash receptacles or dumpsters owned by the Buncombe County Board of Education. All trash and removed materials shall be properly disposed of off the property. Onsite dumpsters shall not be used.

Changes during project: Changes during the project shall only be made by written direction signed by the owner. No additional cost to the contract shall be allowed unless accepted in writing by the owner before work has begun.

Submittal: Within one week of acceptance of contract, performance data, installation manuals, operation manuals (3 copies) and time schedule must be submitted to the owner for approval. Send to Buncombe County Schools Maintenance Department, 175 Bingham Road, Asheville, NC 28806, ATTN: Ron Griffin.

Price Adjustments:(Term Contracts Only) Any price changes, downwards or upward, which might be permitted during the contract period must be general, either by reason of market change or on the part of the contractor to the other customers.

a. **Notification**: Must be given to Buncombe County Schools, in writing, concerning any proposed price adjustments. Such notification shall be accompanied by copy of manufacturer's official notice or other acceptable evidence that the change is general in nature.

b. **Decreases**: Buncombe County Schools shall receive full proportionate benefit immediately at any time during the contract.

c. **Increases**: **Consumer Price Index (CPI)**: Contract prices for equipment and/or service will remain firm through June 30, 2020. Contractors must request price adjustments, in writing, 30 days prior to the renewal date. If a Contractor fails to request CPI price adjustment 30 days prior to the adjustment date, the adjustment will be effective 30 days after Buncombe County Schools receives their written request. Price adjustments will be made in accordance with the percentage change in the U.S. Department of Labor Consumer Price Index (CPI-U) for all urban consumers, all items, southern region.

The price adjustment rate will be determined by comparing the percentage difference between the CPI in effect for the base yearly average (January through December beginning the year 2020); and each (January through December) thereafter. The percentage difference between those two CPI issues will be the price adjustment rate. No retroactive contract price adjustments will be allowed. All bidders will be capped with a 3% maximum price increase.

d. **Invoices**: It is understood and agreed that orders will be shipped at the established contract prices in effect on dates orders are placed. Invoicing at variance with this provision will subject the contract to cancellation. Applicable North Carolina sales tax shall be invoiced as a separate item.

Payment: One block payment shall be made when all work is completed.

Final documents required:

1. Letter to the project manager from contractor which states all work is completed and payment is desired.
2. Delivery to owner, copies of all permits, certifications of inspection issued by the authorities having jurisdiction

Performance of Work: All work shall be performed at the highest level of quality. The Owner shall be responsible for determining the quality of work and may notify the Contractor of same. ANY WORK COMPLETED THAT IS NOT SUITABLE TO THE OWNER SHALL BE REPEATED BY THE CONTRACTOR AT NO COST TO THE OWNER. Any damage to existing area or utilities will be the responsibility of the Contractor. NO EXCEPTIONS.

Warranty: All labor, material and equipment shall be warranted for one (1) year from issuance of inspection.

Contractor must adhere to the guidelines within these specifications; failure to do so will result in default of payment by the BCBOE and/or cancelation of this contract.

The Buncombe County Board of Education reserves the right to reject any or all bids or any or no reason.

End of RFP# 1-20

HVAC UPGRADES
LEICESTER ELEMENTARY SCHOOL

BUNCOMBE COUNTY SCHOOLS
ASHEVILLE, NORTH CAROLINA

DECEMBER 10, 2019

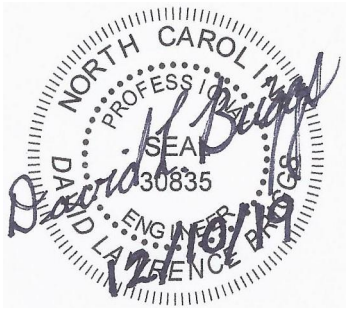
SUD ASSOCIATES, P.A.
CONSULTING ENGINEERS
ASHEVILLE, NORTH CAROLINA
License No. C-0315

HVAC UPGRADES
LEICESTER ELEMENTARY SCHOOL

BUNCOMBE COUNTY SCHOOLS
ASHEVILLE, NORTH CAROLINA

DECEMBER 10, 2019

Mechanical



Electrical

SUD ASSOCIATES, P.A.
Consulting Engineers
License No. C-0315
20 Battery Park Ave., Suite 706
Asheville, North Carolina 28801
(828) 255-4691

HVAC UPGRADES
LEICESTER ELEMENTARY SCHOOL

BUNCOMBE COUNTY SCHOOLS
ASHEVILLE, NORTH CAROLINA

TABLE OF CONTENTS

DIVISION 01

GENERAL

SECTION 010100

SUMMARY OF THE WORK

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings, Notice to Bidders and Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

PROJECT/WORK IDENTIFICATION

General: Project name is Leicester Elementary HVAC Upgrades, Buncombe County Schools, as shown on Contract Documents prepared by Sud Associates, P.A. Drawings and Specifications are dated December, 2019.

Contract Documents: Indicate the work of the Contract and related requirements and conditions that have an impact on the project. Related requirements and conditions that are indicated on the Contract Documents include, but are not necessarily limited to, the following:

Existing site conditions and restrictions on use of the site.
Work performed prior to work under this Contract.
Alterations and coordination with the existing building.
Work to be performed concurrently by others.

Scope: As shown and described on the drawings.

Summary by References: Work of the Contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda and modifications to the contract documents issued subsequent to the initial printing of this project manual and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions and other forces outside the contract documents.

CONTRACTOR USE OF PREMISES

General: The Contractor shall limit his use of the premises to the work indicated, so as to allow for Owner occupancy and use.

Use of the Site: Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times. Do not use these areas for parking or storage of materials.

Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas indicated. If additional storage is necessary obtain and pay for such storage off site.

Lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

Contractor Use of the Existing Building: Maintain the existing building in a safe and weather tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. Smoking or open fires will
not be permitted within the building enclosure or on the premises.

OWNER OCCUPANCY

Full Owner Occupancy: The Owner will occupy the site and the existing building during the entire period of construction. Cooperate fully with the Owner or his representative during construction operations to minimize conflicts and to facilitate Owner usage. Perform the work so as not to interfere with the Owner's operations.

DISCREPANCIES IN DRAWINGS AND SPECIFICATIONS

Should the Contractor find discrepancies or ambiguities in, or omissions from, the Drawings or Specifications,
or should he be in doubt as to their meaning, he shall at once notify the Engineer, who will issue an interpretation.

ALTERATIONS AND COORDINATION

General: The work of this Contract includes coordination of the entire work of the project, including preparation of general coordination drawings, diagrams and schedules, and control of site utilization, from beginning of construction activity through project closeout and warranty periods.

Electrical Requirements: Except as otherwise indicated, comply with applicable provisions of The National Electrical Code (NEC) and standards by National Electrical Manufacturer's Association (NEMA), for electrical components of general work. Provide Underwriters Laboratories listed and labeled products where applicable

COMPLIANCE WITH FEDERAL AND STATE LAWS AND REGULATIONS

General: Contractor including his subcontractors shall comply with all applicable federal, state and local laws and regulations.

Administrative Requirements: The Contractor shall provide any documents required to comply with administrative and legal requirements. These include summary reports of sales tax and other assessments, as requested by the Owner, etc.

Permits: The Contractor shall obtain all necessary permits and approvals required to perform the work. These permits and approvals shall be provided at no cost to the Owner.

Inspection Certificates: It shall be the responsibility of the Contractor to request and coordinate inspections. Obtain all inspection certificates required by law, ordinances, rules and regulations of the Authorities having jurisdiction. Provide to the Engineer certificates of such inspections; pay all fees, charges, and other expenses in connection therewith, prior to final payment. Final payment will be made within thirty (30) consecutive days after acceptance of the work and the submission of notarized contractor's affidavit and letter certifying that no hazardous materials were introduced. The contractor's affidavit shall state: “This is to certify that all costs of materials, equipment, labor, and all else entering into the accomplishment of this contract, including payrolls, have been paid in full.” The contractor’s certification letter shall state: “This is to certify that no hazardous materials, including lead, asbestos, or PCB's were introduced into the building during the course of this project. If it is discovered at a later

date that an asbestos-containing product was used, (name of contractor) will remove it and restore the project to its original working condition at no cost to the Owner."

SPECIAL REQUIREMENT

Interruption of Utilities: The buildings will be occupied during construction. Any interruption of utilities (electricity, water, heating, cooling, etc.) shall be minimized and undertaken through the owner with at least 72 hours advanced notice. If necessary, work must be done at night, or over the weekend, or during holidays to minimize interruptions. No extra payment will be made for such work.

Access to Buildings: The owner will make necessary arrangements for access to the premises. Coordinate with the Owner for all locked areas. It is the Contractor's responsibility to see that no un-authorized person gains access to construction areas. The Contractor shall coordinate with the Owner, if access is required beyond normal working hours.

Employee Conduct: At any time during the construction and completion of the work covered by these specifications, if the conduct of any workman of the various crafts be adjudged ungentlemanly and a nuisance to the Owner or Engineer or if any workman be considered incompetent or detrimental to the work, the Contractor shall order such parties removed immediately from the grounds.

EXAMINATION OF PREMISES

Each Bidder prior to submitting a proposal shall examine the site and all conditions thereon. All proposals will be presumed to include all such existing conditions as may affect any work of this project; and failure to familiarize himself with any such conditions will in no way relieve the successful bidder from the necessity of furnishing all materials or performing any work that may be required to complete the work in accordance with the drawings and specifications, without additional cost to the Owner. Examination of premises shall be scheduled, by prior appointment only, with:

Mr. Jamie Messer, Facilities Maintenance
Buncombe County Schools
175 Bingham Rd.
Asheville, NC 28806 Telephone: (828) 232-4244

CORRESPONDENCE TO THE OWNER AND ENGINEER

All papers required to be delivered to the Owner shall, unless otherwise directed in writing to the Contractor, be delivered to Sud Associates, P.A., Flat Iron Building, Suite 706, 20 Battery Park Avenue, Asheville, North Carolina, 28801. Copies of correspondence to the Engineer shall be sent to the Owner, in care of, Mr. Jamie Messer, Facilities Maintenance, Buncombe County Schools, 175 Bingham Rd., Asheville, NC 28806.

PARKING REQUIREMENT

The contractor shall consult with the Owner for permissible parking locations and at all times shall endeavor to permit normal movement of vehicle and pedestrian traffic near the job site. The Contractor shall also coordinate with the Owner for location of site trailer if one is required.

THE CONTRACT DOCUMENTS

The Contract Documents consist of Notice to Bidders, Standard General Conditions of the Construction Contract, Supplementary General Conditions, all sections of Division 1, the Drawings, and Specifications, including all bulletins, addenda, or other modifications of the Drawings and Specifications incorporated into the documents prior to their execution, the Proposal Form and

supporting information submitted by the Contractor, the Contract Form, the Payment and Performance Bonds, Power of Attorney, and Insurance Certificates evidencing the needed coverages. All of these items together form the Contract Documents.
The contract will be awarded to the lowest responsible bidder for the entire work covered under this contract. Summary reports of sales tax and other assessments, as requested by the Owner, shall be provided.

END OF SECTION

SECTION 010400

PROJECT COORDINATION

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings, Notice to Bidders and Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK

Minimum administrative and supervisory requirements necessary for coordination of work on the project include but are not necessarily limited to the following:

Coordination and meetings.
Administrative and supervisory personnel.
Limitations for use of site.
Special reports.
General installation provisions.
Cleaning and protection.
Conservation and salvage.

LIMITATIONS ON USE OF THE SITE

General: Limitations on site usage as well as specific requirements that impact site utilization are indicated on the drawings and by other contract documents. In addition to these limitations and requirements, administer allocation of available space equitably among entities needing both access and space so as to produce the best overall efficiency in performance of the total work of the project. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site.

Burial of Waste Materials: Do not dispose of organic and hazardous materials on site, either by burial or by burning.

Disposal: Owner shall identify any demolished items removed from the structures that he wants to retain. All such items shall be delivered to Owner in accordance with his instructions. Contractor shall remove from site all other demolished items (i.e. mechanical equipment, lighting fixtures, wire, etc.) Removed from the structures and dispose of them by legal means. The Contractor will assume full liability for the disposal of all demolished items removed from the site.

SPECIAL REPORTS

General: Submit special reports directly to the Owner within one day of an occurrence. Submit a copy of the report to the Designer and other entities that are affected by the occurrence.

Reporting Unusual Events: When an event of an unusual and significant nature occurs at the site, prepare and submit a special report. List chain of events, persons participating, response by the Contractor's personnel, an evaluation of the results or effects and similar pertinent information. Advise the Owner in advance when such events are known or predictable.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

Installer's Inspection of Conditions: Require the Installer of each major unit of work to inspect the substrate to receive work and conditions under which the work is to be performed. The Installer shall report all unsatisfactory conditions in writing to the Contractor. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to the Installer.

Manufacturer's Instructions: Where installations include manufactured products, comply with the manufacturer's applicable instructions and recommendations for installation, to the extent that these instructions and recommendations are more explicit or more stringent than the requirements indicated in the contract documents.

Inspect each item of materials or equipment immediately prior to installation. Reject damaged and defective items.

Provide attachment and connection devices and methods for securing work. Secure work true to line and level, and within recognized industry tolerances. Allow expansion and building movement. Provide uniform joint width in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable visual-effect choices to the Owner for final decision.

Recheck measurements and dimensions of the work, as in integral step of starting each installation.

Install each unit-of-work during weather conditions and project status which will ensure the best possible results in coordination with the entire work. Isolate each unit of work from incompatible work as necessary to prevent deterioration.

Coordinate enclosure of the work with required inspections and tests, so as to minimize the necessity of uncovering work for that purpose.

Mounting Heights: Where mounting heights are not indicated, mount individual units of work at industry recognized standard mounting heights for the particular application indicated. Refer questionable mounting height choices to the Designer for final decision.

CLEANING AND PROTECTION OF EXISTING AND NEW WORK

General: During handling and installation of work at the project site, clean and protect work in progress and adjoining work on the basis of continuous maintenance. Apply protective covering on installed work where it is required to ensure freedom from damage or deterioration at time of substantial completion. Clean and perform maintenance on installed work as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

Limiting Exposures of Work: To the extent possible through reasonable control and protection methods, supervise performance of the work in such a manner and by such means which will ensure that none of the work, whether completed or in progress, will be subjected to harmful, dangerous or otherwise deleterious exposure during the construction period. Such exposures include, where applicable, but not by way of limitation the following:

Excessive static or dynamic loading.

Excessive internal or external pressures.
Excessively high or low temperatures.
Thermal shock.
Excessively high or low humidity.
Air contamination or pollution.
Water or ice.
Solvents.
Chemicals.
Light.
Radiation.
Puncture.
Abrasion.
Heavy traffic.
Soiling.
Bacteria.
Insect infestation.
Combustion.
Electrical current.
High speed operation, improper lubrication, unusual wear or other misuse.
Incompatible interface.
Destructive testing.
Misalignment.
Excessive weathering.
Unprotected storage.
Improper shipping or handling.
Theft.
Vandalism.

END OF SECTION

SECTION 016310

PRODUCTS AND SUBSTITUTIONS

PART 1 - GENERAL

RELATED DOCUMENTS

Drawings, Notice to Bidders and Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF REQUIREMENTS

Definitions: Definitions used in this paragraph are not intended to negate the meaning of other terms used in the contract documents, including such terms as, "specialties," "systems," "structure," "finishes," "accessories," "furnishings," "special construction" and similar terms. Such terms are self-explanatory and have recognized meanings in the construction industry.

"Products" are items purchased for incorporation in the Work, regardless of whether they were specifically purchased for the project or taken from the Contractor's previously purchased stock. The term "product" as used herein includes the terms "material," "equipment," "system" and other terms of similar intent.

"Named Products" are products identified by use of the manufacturer's name for a product, including such items as a make or model designation, as recorded in published product literature, of the latest issue as of the date of the contract documents.

"Materials" are products that must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form units of work.

"Equipment" is defined as a product with operational parts, regardless of whether motorized or manually operated, and in particular, a product that requires service connections such as wiring or piping.

Substitutions: The Contractor's requests for changes in the products, materials, equipment and methods of construction required by the contract documents are considered requests for "substitutions," and are subject to the requirements specified herein. The following are not considered as substitutions:

Revisions to the contract documents, where requested by the Owner or Engineer are considered as "changes" not substitutions.

Substitutions requested during the bidding period, which have been accepted prior to the Contract Date, are included in the contract documents and are not subject to the requirements for substitutions as herein specified.

Specified Contractor options on products and construction methods included in the contract documents are choices available to the Contractor and are not subject to the requirements for substitutions as herein specified.

Except as otherwise provided in the contract documents, the Contractor's determination of and compliance with governing regulations and orders as issued by governing authorities do not constitute "substitutions" and do not constitute a basis for change orders.

Standards: Refer to Division-1 section "Definitions and Standards" for the applicability of industry standards to the products specified for the project, and for the acronyms used in the text of the specification sections.

QUALITY ASSURANCE

Source Limitations: To the fullest extent possible, provide products of the same generic kind, from a single source, for each unit of work.

Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract documents, but must be provided by the Contractor.

SUBMITTALS

Product Listing Submittal:

General: Prepare a product-listing schedule in a form acceptable to the Designer. Show names of the principal products required for the work, by generic name. Show proprietary product names and the name of the manufacturer for each item listed that is to be purchased and incorporated into the Work.

Refer to Division 15A sections for a special separate listing of products required for Direct Digital Control work.

Form: Prepare the product-listing schedule with information on each item tabulated under the following scheduled column headings:

Generic name as used in contract documents.
Proprietary name, model number and similar product designation.
Manufacturer's and supplier's name and city-state addresses.
Related unit-of-work specification section number.
Installer's name and primary trade of workmen.
Projected delivery date, or time span of delivery period.

Submittal: Submit three (3) copies of the product-listing schedule within 20 days after the date of award of contract. Provide a written explanation for omissions of data, and for known variations from contract requirements.

Designer's Action: The Designer will respond to the Contractor in writing within two (2) weeks of receipt of the product-listing schedule. No response by the Designer within the 2 week time period constitutes no objection to the listed products or manufacturers, but does not constitute a waiver of the requirement that products comply with the requirements of the contract documents. The Designer's response will include the following:

The Designer's listing of unacceptable product selections, if any, containing an explanation of the reasons for this action.

A request for additional data necessary for the review and possible acceptance of the products and manufacturer's listed.

Substitution Request Submittal:

Requests for Substitutions: Submit all requests for substitutions at least 10 days prior to the opening of bids. Submit 3 copies of each request for substitution. In each request identify the product or fabrication or installation method to be replaced by the substitution; include related specification section and drawing numbers, and complete documentation showing compliance with the requirements for substitutions. Include the following information, as appropriate, with each request:

Provide complete product data, drawings and descriptions of products, and fabrication and installation procedures.

Provide samples where applicable or requested.

Provide a detailed comparison of the significant qualities of the proposed substitution with those of the work originally specified. Significant qualities include elements such as size, weight, durability, performance and visual effect where applicable.
Provide complete coordination information. Include all changes required in other elements of the work to accommodate the substitution, including work performed by the Owner and separate Contractors.

Provide a statement indicating the effect the substitution will have on the work schedule in comparison to the schedule without approval of the proposed substitution. Include information regarding the effect of the proposed substitution on the Contract Time.

Provide certification by the Contractor to the effect that, in the Contractor's opinion, after thorough evaluation, the proposed substitution will result in work that in every significant respect is equal-to or better than the work required by the Contract documents, and that it will perform adequately in the application indicated.

Include in this certification, the Contractor's waiver of rights to additional payment or time, which may subsequently be necessary because of the failure of the substitution to perform adequately.

Designer's Action: Within one week of receipt of the Contractor's request for substitution, the Designer will request additional information or documentation as may be needed for evaluation of the request. Within 2 weeks of receipt of the request, or within one week of receipt of the requested additional information or documentation, which ever is later, the Designer will notify the Contractor of either the acceptance or rejection of the proposed substitution.

Rejection will include a statement giving reasons for the rejection.

PRODUCT DELIVERY, STORAGE, AND HANDLING

General: Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft. Control delivery schedules to minimize long-term storage at the site and to prevent overcrowding of construction spaces. In particular coordinate delivery and installation to ensure minimum holding or storage times for items known or recognized to be flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other sources of loss.

Deliver products to the premises in the manufacturer's sealed container or other packaging system, complete with labels and instructions for handling, storage, unpacking, protecting and installing. Owner's personnel will not accept delivered materials - arrangements must be made by Contractor concerned to have Contractor's own personnel accept all deliveries of construction materials.

Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

Store heavy materials away from the project structure in a manner that will not endanger the supporting construction.

PART 2 – PRODUCTS

GENERAL PRODUCT COMPLIANCE

General: Requirements for individual products are indicated in the contract documents; compliance with these requirements is in itself a contract requirement. These requirements may be specified in any one of several different specifying methods, or in any combination of these methods. These methods include the following:

Proprietary.
Descriptive.
Performance.
Compliance with Reference Standards.
Compliance with codes, compliance with graphic details, allowances, and similar provisions of the contract documents also have a bearing on the selection process.

Procedures for Selecting Products: The Contractor's options in selecting products are limited by requirements of the contract documents and governing regulations. They are not controlled by industry traditions or procedures experienced by the Contractor on previous construction projects. Required procedures include but are not limited to the following for the various indicated methods of specifying:

Proprietary and Semiproprietary Specification Requirements:

Three or More Product Names: Where three or more products or manufacturers are named, provide one of the products named, at the Contractor's option. Exclude products that do not comply with specification requirements. In accordance with the Supplementary General Conditions submit all requests for substitutions prior to the opening of bids. Do not provide or offer to provide an unnamed product that was not approved prior to the opening of bids. Advise the Designer before proceeding where none of the named products comply with specification requirements, or are feasible for use.

Where products or manufacturers are specified by name, accompanied by the term "or-equal" or similar language, comply with the contract document provisions concerning "substitutions" to obtain approval from the Designer prior to the opening of bids for the use of an unnamed product.

Non-Proprietary Specification Requirements: Where the specifications name products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to the use of these products only, the Contractor may, at his option, use any available product that complies with contract requirements.

Descriptive Specification Requirements: Where the specifications describe a product or assembly generically, in detail, listing the exact characteristics required, but without use of a brand or trade name, provide products or assemblies that provide the characteristics indicated and otherwise comply with contract requirements.

Performance Specification Requirements: Where the specifications require compliance with indicated

performance requirements, provide products that comply with the specific performance requirements indicated, and that are recommended by the manufacturer for the application indicated. The manufacturer's recommendations may be contained in published product literature, or by the manufacturer's individual certification of performance. General overall performance of a product is implied where the product is specified for specific performances.

Compliance with Standards, Codes and Regulations: Where the specifications require only compliance with an imposed standard, code or regulation, the Contractor has the option of selecting a product that complies with specification requirements, including the standards, codes and regulations. The burden of proof-of-compliance is on the Contractor.

Visual Matching: Where matching an established sample is required, the final judgment of whether a product proposed by the Contractor matches the sample satisfactorily will be determined by the Designer. Where there is no product available within the specified product category that matches the sample satisfactorily and also complies with other specified requirements, comply with the provisions of the contract documents concerning "substitutions" and "change orders" for the selection of a matching product in another product category, or for non-compliance with specified requirements.

Visual Selection: Except as otherwise indicated, where specified product requirements include the phrase "...as selected from the manufacturer's standard colors, patterns, textures..." or similar phrases, the Contractor has the option of selecting the product and manufacturer, provided the selection complies with other specified requirements. The Designer is subsequently responsible for selecting the color, pattern and texture from the product line selected by the Contractor.

Producer's Statement of Applicability: Where individual specification sections indicate products that require a "Statement of Applicability" from the manufacturer or other producer, submit a written-certified statement from the producer stating that the producer has reviewed the proposed application of the product on the project. This statement shall state that the producer agrees with or does not object to the Designer's specification and the Contractor's selection of the product for use in the Work. The statement shall also state that the proposed application of the product on the project is suitable and proper.

SUBSTITUTIONS

Conditions: Before the Bid Opening in accordance with the Supplementary General Conditions, the Contractor's request for a substitution will be received and considered when extensive revisions to the contract documents are not required, when the proposed changes are in keeping with the general intent of the contract documents, when the requests are timely, fully documented and properly submitted, and when one or more of the following conditions is satisfied, all as judged by the Designer; otherwise the requests will be returned without action except to record non-compliance with these requirements.

The Designer will consider a request for substitution where the request is directly related to an "or equal" clause or similar language in the contract documents.

The Designer will consider a request for substitution where the specified product or method cannot be provided within the Contract Time. However, the request will not be considered if the product or method cannot be provided as a result of the Contractor's failure to pursue the work promptly or to coordinate the various activities properly.

The Designer will consider a request for substitution where the specified product or method cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

The Designer will consider a request for a substitution where a substantial advantage is offered the

Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. These additional responsibilities may include such considerations as additional compensation to the Designer for redesign and evaluation services, the increased cost of other work by the Owner or separate contractors, and similar considerations.

The Designer will consider a request for substitution when the specified product or method cannot be provided in a manner which is compatible with other materials of the work, and where the Contractor certifies that the substitution will overcome the incompatibility.

The Designer will consider a request for substitution when the specified product or method cannot be properly coordinated with other materials in the work, and where the Contractor certifies that the proposed substitution can be properly coordinated.

The Designer will consider a request for substitution when the specified product or method cannot receive a warranty as required by the contract documents and where the contractor certifies that the proposed substitution receive the required warranty.

Work-Related Submittals: The Contractor's submittal of and the Designer's acceptance of shop drawings, product data or samples which relate to work not complying with requirements of the contract documents, does not constitute an acceptable or valid request for a substitution, nor approval thereof.

GENERAL PRODUCT REQUIREMENTS

General: Provide products that comply with the requirements of the Contract documents and that are undamaged and, unless otherwise indicated, unused at the time of installation. Provide products that are complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
Standard Products: Where they are available, provide standard products of types that have been produced and used in similar situations on other projects.

Continued Availability: Where, because of the nature of its application, the Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced products for which the manufacturer has published assurances that the products and its parts are likely to be available to the Owner at a later date.
Nameplates: Except as otherwise indicated for required labels and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on the exterior of the completed project.

Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate the nameplate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data.

Name of manufacturer.
Name of product.
Model number.
Serial number.
Capacity.
Speed.

Ratings.
U.L. listed label on all electrical equipment.

PART 3 - EXECUTION

INSTALLATION OF PRODUCTS

General: Except as otherwise indicated in individual sections of these specifications, comply with the manufacturer's instructions and recommendations for installation of the products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect surfaces as necessary to ensure freedom from damage and deterioration at time of acceptance.

END OF SECTION

SECTION 017500

ALTERNATES

PART 1 - GENERAL

1.01 GENERAL

A. All work under this heading is subject to all Contract Documents, and includes the furnishing of all labor, materials, equipment, accessories, etc. for the complete installation of all Alternates as outlined in this Specification Section.

PART 2 – ALTERNATES

2.01 ALTERNATES

A. Alternate 1 – Install domestic hot water preheat using water to water heat pumps as shown on drawings.
B. Alternate 2 – Remove and replace kitchen heating and makeup air unit as shown on drawings.
C. Alternate 3 – Brand alternate: Install Weil McLain cast iron sectional boilers.

END OF SECTION

DIVISION 23

MECHANICAL

SECTION 230510

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 REFERENCES & INTENT

A. All work of this Division shall comply with the requirements of the Drawings, General Conditions, Supplementary General Conditions and Division 01 Specifications section.

B. Study all drawings and specifications before submitting bids.

C. Work under this Division includes all essential labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items for proper installation and operation of all systems even though not specifically mentioned or indicated.

D. Drawings are diagrammatic. Drawings are not intended to be absolutely precise and do not specify or show every offset, fitting, and component. The purpose of the drawings is to indicate a system concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational. Contractor shall route piping or provide offsets to avoid interference with structural elements, equipment, electrical panels and junction boxes, etc. Verify locations, dimensions, flow directions, etc. before construction.

E. It is the intent of these specifications and drawings to provide for finished systems of the quality specified, properly tested, balanced and ready for operation. This includes all devices and accessories required to make the work complete even though such items may not be expressly shown or specified. Drawings and specifications are complementary and must be so construed to determine the full scope of work.

F. Jobsite Conditions: The Contractor shall visit the site and familiarize himself with the existing conditions before submitting his bid. Failure to do so does not relieve the Contractor from completing the work as specified herein and after. Requests for additional payments due to the Contractor's failure to allow for work conditions will be rejected.

1.02 WORK INCLUDED

A. The following work is specifically included without limiting the generality implied by these specifications and drawings.
   1. All mechanical scope of work specified herein and as shown on the plans. Contractor should review all drawings and include all items that are a part of his scope.
   2. All associated wiring, cutting and patching.

B. Bidders shall examine equipment plans and specifications and include in their bids all labor and material required for complete installation and connection of equipment which is properly a part of their trade even if it is not provided in the equipment specifications.

1.03 STANDARDS AND CODES

A. All equipment with electrical components shall bear the UL label.

B. The following minimum standards apply wherever applicable:

ANSI	American National Standards
ASTM	American Society for Testing Materials
NBFU	National Board of Fire Underwriters
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal & Air Conditioning Contractors National Association, Incorporated

North Carolina Building Code
Any Other Applicable local and State Codes

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

1.04 PERMITS AND FEE

A. Make application for all necessary permits and pay applicable fees.

1.05 STRUCTURAL STEEL AND CONCRETE

A. Structural members may not be pierced without prior written approval of the Engineer.

1.06 WATERPROOFING

A. Waterproofed floors and walls may not be cut.

1.07 WORK SCHEDULE

A. Work schedule shall be in accordance with Division 01.

B. Any demolition or installation work producing excessive dust or noise deemed to be disruptive or possibly unsafe to building operations must be, at the Owner's discretion, performed after normal working hours.

1.08 PROTECTION OF EQUIPMENT

A. Provide all necessary protection and be fully responsible for material and equipment stored or installed on the site. Material or equipment stolen or damaged shall be replaced at no additional cost to the Owner.

B. Provide protection against theft, physical damage and the entry of dirt, water or corrosive fumes into the material and equipment. Maintain protective covers for the duration of construction. Store equipment, such as controls, subject to damage by moisture and temperature extremes in a dry, heated space.

C. For all cutting, burning and welding operations a burn permit is required. This permit may be obtained from the University at no cost.

1.09 FIRE SAFETY

A. Fire Watch: Provide a fire watch wherever welding, brazing, cutting or other processes

involving an open flame or potential for generating sparks is used. Fire watch shall consist of a person with a 10 pound carbon dioxide fire extinguisher. While on fire watch, the person so assigned shall have no other duties or assignments.

B. Fire Blanket: In addition to providing a fire watch, use an approved fire blanket to cover any combustible materials in the immediate area.

1.10 GUARANTEES

A. Furnish written guarantee with a minimum of 1 year warranty on the entire system. For boilers, pumps, kitchen makeup air unit, and WWHPs, furnish a 5 year full coverage parts and labor warranty. Partial approval of a portion of work does not affect the validity of guarantee.

1.11 SHOP DRAWINGS

A. It shall be noted that shop drawing submittals processed by the Engineer are not change orders; that the purpose of shop drawing submittals is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. If deviations, discrepancies or conflicts between shop drawing submittals and the contract documents in the form of design drawing and specifications are discovered either prior to or after shop drawing submittals are processed by the Engineer, the design drawings and specifications shall control and shall be followed. The Engineer may also require the contractor to submit samples of proposed or specified equipment for approval with the samples to be returned to the contractor upon request.

B. Prior to procurement or manufacturing, submit for approval appropriate shop drawings and/or descriptive literature giving performance data, physical size, wiring diagrams, configuration, capacity, material, etc., for all items under this Division including the following:

1. Hydronic Piping & Piping Specialties
2. General Duty Valves for HVAC
3. Variable Speed Drives
4. Mechanical Painting & ID
5. Testing & Balancing
6. HVAC Insulation
7. DDC Controls, Valves and Actuators
8. Pumps
9. Refrigerant Piping & Piping Specialties
10. Water Conditioning
11. Ductwork, Dampers, & Louvers
12. Air Distribution
13. Boilers & Breeching
14. Chiller
15. ERV, AHU, FCU, UV, Ductless Split System Heat Pumps, Coils, & Convector.

C. The contractor shall visit the site and familiarize himself with the project requirements and the field conditions before preparing shop drawings and ordering equipment. Field verify the characteristics of all specified or existing equipment before preparing shop drawings. This shall include available space, available voltages, suitability of substrate for receiving the specified equipment, etc. Where existing equipment is re-used, he shall verify dimensions, capacities, horse-power, etc. and bring any discrepancies to the attention of the Engineer.

D. Where different products have to work together, it is the Contractor’s responsibility to select manufacturers whose products are visually and/or technically compatible.

E. Prepare listing of all equipment and materials for the project. A sample schedule is included at the end of this section to complete this requirement. Provide all information represented.

1.12 RECORD DRAWINGS

A. During construction, keep an accurate record of all changes and deviations from contract documents. Upon completion of this installation, the contractor shall submit to the Engineer marked up prints indicating any installed work that is different from what is shown on the drawings. Complete and accurate drawings shall be submitted to the Owner at the conclusion of this project. All changes will be reflected in CAD format. Marked-up as-built drawings will not be permitted.

PART 2 PRODUCTS

2.01 QUALITY OF MATERIAL

A. Equipment of the same general type shall be of the same make. Reference is made to relays, motors, valves, motor starters, contactors, etc.

B. Brand names and catalog numbers included with equipment or material specifications are used to indicate quality, rating or operating characteristics of the equipment or material.

C. All materials provided shall be new and shall be approved and labeled by the Underwriter's Laboratories, Inc., or other accredited third party agency, wherever such agency has applicable standards. All work shall be accomplished in a neat, workmanlike manner by experienced journeymen. All work shall be performed at such times as are required by the progress of the job.

D. All components, equipment and systems shall comply with ASHRAE 90.1 and any other applicable ASHRAE standard.

PART 3 EXECUTION

3.01 CLEARANCE AND RESTORATION OF SITE

A. It may be required to temporarily remove existing ceiling tiles, piping, duct, conduits, etc. to introduce new work as specified in this Division. Contractor, after installation of new work, shall reinstall, reconnect removed items to match the existing. Installation of any new equipment shall not compromise existing fire ratings of rated assemblies. All penetrations shall be sealed to existing conditions per UL guidelines for penetration protections. Provide offsets if required in existing piping, ducts etc. to introduce new work.

3.02 COORDINATION

A. Install all work to permit removal of equipment without damage to the equipment or the building. Verify equipment space requirements, condition of substrate, voltages, etc. at the time of shop drawing submission and advise the Engineer of any conflict.

B. Coordinate equipment locations as well as piping and conduit routing with Owner's representative to optimize all present and foreseen future space usage and clearance

requirements.

C. Do not rough prior to receipt of approved shop drawings.

3.03 EQUIPMENT INSTALLATION AND SUPPORT

A. Install all equipment where indicated, in accordance with manufacturer's published installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes. Consult with Engineer if said instructions or practices conflict with the drawings/specifications.

B. Support plumb, rigid and true to line all work and equipment furnished under this Division. Study thoroughly architectural, mechanical drawings and all related drawings to determine how equipment, piping, ductwork, etc., are to be supported, mounted or suspended. Provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support as required whether or not shown on drawings. When directed, furnish for approval a drawing showing supports.

C. Any system component which may require maintenance, such as control valves, manual valves, strainers, etc. shall not be installed over electrical equipment, machinery, control panels or floor openings.

3.04 FINAL ADJUSTMENT AND TESTING

A. General: Provide all testing, preliminary and final adjustment of instrumentation for this purpose. Conduct all tests in full compliance with applicable codes prior to covering or concealing work by insulation, enclosures, etc. Material found to be defective shall not be repaired. It shall be replaced with new material which tests satisfactorily. Defective workmanship shall be corrected.

B. Working Tests: Subject all equipment and controls to simultaneous and continuous working tests for a period of one day prior to final inspection. Make adjustments, repairs and equipment replacements as required.

3.05 LABELS, IDENTIFICATION AND TAGS

A. All components or equipment shall be identified using 3/4 inch high permanent engraved bakelite nameplates or 3/4 inch high anodized aluminum nameplates, white letter, black background, with minimum 1/4 inch high letters. Nameplates shall be permanently attached with pin-head screws to device or to wall or mounting panel above device. Stick-on type labels will not be acceptable.

3.06 OWNER'S RIGHT TO TEST SYSTEMS

A. Should, in the opinion of the Engineer, and during the guarantee period, reasonable doubt exist as to the proper functioning of any equipment installed under this Contract, the right is reserved for the Owner and Engineer to perform any test deemed practical to determine whether such equipment is functioning properly and performing at required capacity. If such tests show proper functioning, the cost of the test will be paid by the Owner. If the tests indicate a deficiency in equipment capacity or performance, the Contractor shall pay the cost of the test and also make good any deficiencies shown by the test to the full satisfaction of the Owner and the Engineer.

3.07 CLEANING UP

A. The contractors performing work under this section shall at all times keep the premises and the building in a neat and orderly condition and any instructions of the Engineer in regard to the storing of material, protective measures, cleaning up of debris, etc. shall be explicitly followed. At the completion of the job, all equipment shall be cleaned to the satisfaction of the Owner.

B. The building will be occupied during installation of the new addition and/or alterations as described hereinafter. Thus, special care shall be taken during installation to protect equipment and other furniture in the buildings from dust and debris generated during installation of work specified in this Division.

3.08 INSPECTION CERTIFICATES

A. Obtain all inspections required by law, ordinances, rules, and regulations of the Authorities having jurisdiction and obtain and furnish to the Engineer certificates of such inspections, pay all fees, charges, and other expenses in connection therewith.

3.09 FINAL REVIEW

A. Final review and tests of the completed construction shall be performed in the presence of the Engineer or his representative and shall be at such times as are convenient to the Engineer. Final tests shall show conclusively that all equipment performs its intended and specified function and that all work complies with the provisions of these specifications. All material, equipment, and instruments required for the tests shall be furnished by the Contractor at his own expense.

3.10 EQUIPMENT DELIVERY AND PROTECTION

A. All material shall be delivered and unloaded by the Contractor within the project site as directed by the Owner. The Contractor shall protect all material and equipment from breakage, theft or weather damage.

3.11 OPERATING INSTRUCTIONS

A. The Contractor shall provide a minimum of six (6) hours of personal instruction to Owner's personnel in the proper operation of all equipment specified and provided. The instruction shall be provided by factory trained and certified competent personnel.

B. Maintenance Manuals shall be submitted in three (3) copies in vinyl 3-ring binders. Each binder shall have the following:
   1. Service telephone number of the installing company, including an emergency number.
   2. Contact person, phone number, and address of manufacturer or distributor where equipment was purchased.
   3. The manufacturing company's operating and maintenance manuals for each piece of equipment.
   4. Copies of all approved shop drawings.

C. Furnish for each building permanent type charts, framed under glass, mounted where directed as follows:
   1. Service organizations with day and night telephone numbers.

PRODUCTS LISTING FORM

INSTRUCTIONS:

Do not use the terminology "as specified", rather indicate specifically the product proposed.

Prepared by: _____

_____

Date: _____ Project:

SPEC. SECTION	ITEM	MANUFACTURER

END OF SECTION

SECTION 230520

PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-1 Specification section, and other Division 23 sections apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of piping specialties required is indicated on drawings and/or specified in other Division 23 sections, and by requirements of this section.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of piping specialty. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

PART 2 PRODUCTS

2.01 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide stamped steel escutcheons, solid or split hinged, 22 gauge minimum.

2.02 DIELECTRIC UNIONS

A. General: Provide brass ball valves where piping material changes from ferrous to non-ferrous material in order to prevent galvanic action and stop corrosion. Non-metalic dielectric unions shall not be used.

2.03 FIRE BARRIER PENETRATION SEALS

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork in accordance with UL penetration protection guidelines with UL approved components. Refer to fire barrier penetration

detail(s) in construction drawings.

2.04 THERMOMETERS

A. Provide solar digital thermometers for all water temperature display applications as shown on plans and/or as otherwise required by field conditions.

2.05 THERMOMETER WELLS

A. Provide thermometer wells constructed of stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer well.

2.06 FABRICATED PIPING SPECIALTIES

A. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over 1/4" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

B. Pipe Sleeves: Provide pipe sleeves of one of the following: (except where allowed otherwise in non-load bearing and non-fire barrier partitions).

C. Steel-Pipe: Fabricate from Schedule 40 galvanized or black steel pipe; remove burrs.

D. Iron-Pipe: Fabricate from cast-iron or ductile iron pipe; remove burrs.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surfaces.

B. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

C. Fire Barrier Penetration Seals: Comply with UL guidelines and refer to details in drawings.

3.02 INSTALLATION OF TEMPERATURE GAGE

A. General: Install temperature gages in vertical upright post, and tilted so as to be easily read by observer standing on floor.

B. Thermometer Wells: Install in piping tee where indicated, in vertical upright post. Fill well with oil or graphite, secure cap. Install a spare well within twelve inches of each temperature sensor installed under the temperature control section.

3.03 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1"

drain line to drain connection, and run to nearest plumbing floor drain or elsewhere as indicated

B. Pipe Sleeves: Install pipe sleeves where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than pipe run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 1/4" above level floor finish and 3/4" above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

C. All interior pipe sleeves shall be schedule 40 steel, unless otherwise noted.

D. Install iron-pipe sleeves at exterior penetrations, both above and below grade.

3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters, gages and factory-finished surfaces. Replace cracked or broken windows and repair any scratched or marred surfaces with manufacturers' touch-up paint.

END OF SECTION

SECTION 230523

GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-1 Specification sections and other Division 23 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of valves required is indicated on drawings and/or specified in other Division - 23 sections, and by requirements of this section.

1.03 QUALITY ASSURANCE

A. Valve Types: Provide valves of same type by same manufacturer.

B. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

1.04 CODES AND STANDARDS

A. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions."

B. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged – or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves."

1.05 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve orchart for each type and size of valve. Submit valve schedule showing Manufacturer's figure number, size, location, and valve features for each required valve.

PART 2 PRODUCTS

2.01 VALVES

A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

C. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves, 6" and smaller, other than plug valves. Provide gear operators for quarter-turn valves 8" and larger. Provide chain-operated sheaves and chains for overhead valves 8" and larger or as indicated.

2.02 GATE VALVES

A. Comply with the following standards:
1. Cast-Iron Valves: MSS SP-7
2. Bronze Valves: MSS SP-80
3. Steel Valves: ANSI B16.34

2.03 GLOBE VALVES

A. Comply with the following standards:
1. Cast-Iron Valves: MSS SP-85
2. Bronze Valves: MSS SP-80
3. Steel Valves: ANSI B16.34

2.04 BALL VALVES

A. Comply with the following standards:
1. Cast-Iron Valves: MSS SP-72
2. Steel Valves: ANSI B16.34

2.05 BUTTERFLY VALVES

A. Comply with MSS SP-67, "lug" type.

2.06 SWING CHECK VALVES

A. Comply with the following standards:
1. Cast-Iron Valves: MSS SP-71
2. Bronze Valves: MSS SP-80
3. Steel Valves: ANSI B16.34

2.07 WAFER CHECK VALVES

A. General: Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between 2 standard class125 flanges.

2.08 LIFT CHECK VALVES

A. Conform to FCI 74-1 for design, rating and testing.

2.09 VALVE FEATURES

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. Bypass: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving.

C. Drain: Comply with MSS SP-45, and provide threaded pipe plugs.

D. Flanged: Valve flanges complying with ANSI B16.5, (steel), or ANSI B16.24 (bronze).

E. Threaded: Valve ends complying with ANSI B2.1.

F. Butt-Welding: Valve ends complying with ANSI B16.25.

G. Socket-Welding: Valve ends complying with ANSI B16.11.

H. Solder-Joint: Valve ends complying with ANSI B16.18.

I. Flangeless: Valve bodies manufactured to fit between flanges complying with ANSI B16.5 (steel), or ANSI B16.24 (bronze).

J. Pressure Ratings: Unless indicated otherwise, valve pressure ratings shall be as follows:

K. Water System: Class 150 for bronze valves, Class 125 for iron valves.

L. Steam Systems: Bronze gate, check, and globe valves in lines with operating pressures to 150 psi SWP shall be 150-pound class and 200-pound class for higher pressures. Cast iron gate valves in lines with operating pressures to 125 psi SWP shall be 125-pound class and 250-pound class for higher pressures.

NOTE: All piping valves, fittings, and steam specialties furnished under this contract shall be as required for the installation of 150 psi boilers operating between 125 psi and150 psi SWP. (Refer to Section 15570 and 15571 for additional requirements.).

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Except as otherwise indicated, comply with the following requirements:
1. Install valves where required for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping.
2. Locate valves so as to be accessible and so that separate support can be provided when necessary.
3. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable.
4. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.

B. Insulation: Where insulation is indicated, install extended- stem valves, arranged in proper manner to receive insulation.

C. Mechanical Actuators: Install mechanical actuators with chain operators where indicated. Extend chains to about 5' above floor and hook to clips to clear aisle passage.

D. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:
1. Tube Size 2" and Smaller: Soldered-joint valves.
2. Pipe Size 2" and Smaller: Threaded valves.
3. Pipe Size 2-1/2" and Larger: Flanged valves.

E. Valve Stems: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

F. Non Metallic Disc: Shall not be used, except where indicated.

G. Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

H. Fluid Control: Except as otherwise indicated, install gate and butterfly valves to comply with ANSI B31.9. Where throttling is indicated or recognized as principal reason for valve, install butterfly valves.

3.02 INSTALLATION OF CHECK VALVES

A. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of low.

B. Wafer Check Valves: Install between two flanges in horizontal or vertical position, position for proper direction of flow.

C. Lift Check Valves: Install in piping line with stem vertically upward, position for proper direction of flow.

3.03 VALVE SCHEDULE

A. Subject to compliance with "Pressure Ratings" required by Page 15100-3 of these specifications.

3.04 GATE VALVES

Refer to Supplementary Valve Schedule for Equivalents.

A. 2" and Smaller: Class 150, Bronze, screw-in bonnet, rising stem, solid wedge, equivalent to Stockham B-100 for threaded ends or Stockham B-108 for solder ends. Milwaukee 148, Milwaukee 1149 or Grinnel 3010, Grinnel 3010-SJ, respectively.

B. 2-1/2" and Larger: Class 125, flanged ends, iron body, bolted bonnet, solid wedge, bronze mounted, OS&Y rising stem, equivalent to Stockham G-623.

C. Hose End, 2-1/2" and smaller: FM, UL-listed, 175 psi, bronze body, solid wedge, inside screw, nonrising stem, equivalent to Jenkins 707.

D. Threaded End, 2" and smaller: FM, UL-listed, 175 psi, bronze body, solid wedge, outside screw and yoke, rising stem, equivalent to Stockham B-133, Nibco T-1040, or Crane 459.

E. Flanged End, 2-1/2" and larger: FM, UL-listed, 175 psi, iron body, bronze mounted, solid wedge, outside screw and yoke, rising stem, equivalent to Stockham G-634.

3.05 GLOBE VALVES

A. 2" and Smaller: Class 150, Bronze body, screw-in bonnet, integral seat, renewable disc, equivalent to Jenkins 746 for threaded ends or Jenkins 1200 for solder ends.

B. 2-1/2" and Larger: Class 125, flanged ends, iron body, bolted bonnet, renewable seat and disc, bronze mounted, equivalent to Jenkins 613.

3.06 DRAIN VALVES

A. Bronze body, screw-in bonnet, rising stem, composition disc, 3/4" hose outlet, equivalent to NIBCO 73 for threaded ends or NIBCO 72 for solder ends.

3.07 PLUG VALVES

A. 2" and Smaller: 150 psi, bronze body, straightaway pattern, square head,

threaded ends, equivalent to Lunkenheimer 454.

B. 2-1/2" and Larger: 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends, equivalent to Powell 2201.

3.08 BALL VALVES

A. 1" and Larger: 400 psi WWP, bronze body, full port, bronze trim, TFE seats and seals. Valves shall be CONBRACO "Appollo" series, or equivalent.

3.09 BUTTERFLY VALVES

Refer to Supplementary Valve Schedule for equivalents.

A. Butterfly Valves shall be full-tapped lug design suitable for dead-end service. Valves through 6" shall have infinite position handles equipped with adjustable memory stops.

B. Valves for working pressure up to 150 psi and 275 F shall have cast iron body, ductile iron or aluminum bronze discs, stainless steel shaft, and elastomeric seats and o-rings.

C. Valves for working pressure above 150 psi shall have carbon steel body and disc, stainless steel stem, reinforced TFE pressure actuated seat with backing ring, and stuffing box with elastomeric packing, follower, and gland.

D. Valves shall be Jamesbury or equivalent.

3.10 CHECK VALVES

Refer to Supplementary Valve Schedule for equivalents.

A. 2" and Smaller: Class 150, bronze body, horizontal swing, regrind type, Y-pattern, renewable disc, equivalent to Stockham B-319 for threaded ends or Stockham B-309 for solder ends.

B. 2-1/2" and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends, equivalent to Stockham G-931.

C. 2-1/2" and Larger: Class 175, iron body, bronze mounted, renewable composition disc and bronze seat ring, bolted cover, flanged ends, equivalent to Stockham

G-940.

3.11 WAFER CHECK VALVES

A. All Sizes: Cast-iron body, aluminum bronze or plated iron plates, stainless steel stem, Buna-N seat, stainless steel springs, equivalent to Stockham WG-970.

3.12 LIFT CHECK VALVES

A. 2" and Smaller: Class 150, Bronze body, lift type, spring loaded, renewable disc, threaded ends, equivalent to Jenkins 655A.

3.13 SUPPLEMENTARY VALVE SCHEDULE

A. General: Provide selections from the following valves for various valve type listed in Division-15 piping sections.

3.14 GATE VALVES

A. 2" and Smaller: Class 150, bronze, screw-in bonnet, rising stem, solid wedge.

	Threaded Ends	Solder Ends
Fairbanks:	0252	0282
Grinnel:	3010	3010-SJ
Hammond:	IB640	IB635
Jenkins:	47	1242
Lunkenheimer:	2127	2132
Milwaukee:	148	1149
Nibco:	T-111	S111
Powell:	500-S	1821-S
Stockham:	B-100	B-108
Walworth:	55	55-SJ

B. 2" and Smaller: Class 150, bronze, screw-in bonnet, non-rising stem, solid wedge.

	Threaded Ends	Solder Ends
Fairbanks:	0250	0280
Grinnel:	3000	3000-SJ
Hammond:	IB645	IB647
Jenkins:	370	1240
Lunkenheimer:	2129	2133
Milwaukee:	105	1145
Nibco:	T-113	S113
Powell:	507	1822
Stockham:	B-103	B-104
Walworth:	55	4-SJ

C. 2-1/2" and Larger: Flanged ends, Class 125, iron body, bolted bonnet, solid wedge, bronze-mounted.

	OS&Y Rising Stem	Non-Rising Stem
Fairbanks:	0405	0403
Grinnel	6020	6060
Hammond:	IR1140	IR1138
Jenkins:	651C	326
Lunkenheimer:	1430	1428
Milwaukee:	F-2885	F-2882
Nibco:	617	619
Powell:	1793	1787
Stockham:	G-623	G-612
Walworth:	8726-F	8719-F

D. Hose-End, 2-1/2": FM, UL-listed, 175 WWP, bronze body, solid wedge, inside screw, non-rising stem. Provide cap and chain.
Fairbanks: 0210

Jenkins:	707
Lunkenheimer:	366
Nibco:	T-113-HC
Walworth:	115

E. Threaded End, 2" and Smaller: FM, UL-listed, 175 WWP, bronze body, solid wedge, outside screw and yoke, rising stem.

Crane:	459
Fairbanks:	0222
Hammond:	IB681
Jenkins:	275U
Nibco:	T-104-0
Stockham:	B-133
Walworth:	904

F. Flanged End, 2-1/2" and Larger: FM, UL-listed, 175 WWP, iron body bronze mounted, solid wedge, outside screw and yoke, rising stem.

Crane:	467
Fairbanks:	0412
Hammond:	IR1154
Jenkins:	825-A
Nibco:	F-607-0
Stockham:	G-634
Walworth:	8713-F

BUTTERFLY VALVES

A. 6" and Smaller: 150 psi, cast-iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, manual lever and lock.

	Wafer	Lug
Fairbanks:	302	502
Grinnell:	WC-8211	LC-8211
Hammond:	3804	3824
Jamesbury:	815W	815L
Nibco:	WL-082-3	NL-082-3
Powell:	Series 1000	Series 5000
Stockham:	LG-511-BS3E	LG-711-BS3E

Grooved Ends: Vitaulic Series 700

B. 8" and Larger: 150 psi, cast-iron body, extended neck, aluminum bronze disc, reinforced resilient EDPM seat, gear operator.

	Wafer	Lug
Fairbanks:	402	602
Grinnell:	WC-8212	LC-8212
Nibco:	WL-082-5	NL-082-5
Powell:	Series 1000	Series 5000
Stockham:	LG-521-B@3E LD-721-BS3E	
Grooved Ends:	Vitaulic Series 701	

3.16 CHECK VALVES

A. 2" and Smaller: Class 150, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc.

	Threaded Ends	Solder Ends

Fairbanks:	0640	0680
Grinnel:	3300	3300-SJ
Hammond:	IB940	IB941
Jenkins:	92-A	1222
Lunkenheimer:	2144	2145
Milwaukee:	509	1509
Nibco:	T-413	S413
Powell:	578	1825
Stockham:	B-319	B-309
Walworth:	3406	3406-SJ

B. 2-1/2" and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends.

Fairbanks:	0702
Grinnell:	6300
Hammond:	IR1124
Jenkins:	629
Lunkenheimer:	1790
Milwaukee:	F2971
Nibco:	F-918
Powell:	559
Stockham:	G931
Walworth:	8928-F

C. 2-1/2" and Larger: FM, UL-listed, 175 WWP iron body bronze mounted, renewable composition disc and bronze seat ring, bolted cover, flanged ends.

Fairbanks:	071
Jenkins:	729
Nibco:	F-908-W
Stockham:	G-940
Walworth:	8883-LT

END OF SECTION

SECTION 230529

SUPPORTS, ANCHORS AND VIBRATION ISOLATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections, and other Division 23 specification sections apply to work of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
1. Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved where required.
3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS) Standard Compliance: Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

B. Select and apply pipe hangers and supports, complying with MSS SP-69.

C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

D. Terminology used in this section is defined in MSS SP-90.

E. Acceptable Manufacturers: Vibration Mountings and Controls, Inc., Grinnell, Modern, or approved equal.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

PART 2 PRODUCTS

2.01 HORIZONTAL-PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory- fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Yoke Type Pipe Clamps: MSS Type 2.
3. Steel Double Bolt Pipe Clamps: MSS Type 3.
4. Steel Pipe Clamps: MSS Type 4.
5. Adjustable Swivel Pipe Rings: MSS Type 6.

6. Adjustable Steel Band Hangers: MSS Type 7.
7. Adjustable Band Hangers: MSS Type 9.
8. Adjustable Swivel Rings, Band Type: MSS Type 10.
9. Split Pipe Rings: MSS Type 11.
10. Extension Split Pipe Clamps: MSS Type 12.
11. U-Bolts: MSS Type 24.
12. Clips: MSS Type 26.
13. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
    a. Plate: Unguided type.
    b. Plate: Guided type.
    c. Plate: Hold-down clamp type.
14. Pipe Saddle Supports: MSS Type 36, including steel pipe base- support and cast-iron floor flange.
15. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.
16. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast-iron floor flange.
17. Single Pipe Rolls: MSS Type 41.
18. Adjustable Roller Hangers: MSS Type 43.
19. Pipe Roll Stands: MSS Type 44.
20. Adjustable Pipe Roll Stands: MSS Type 46.

2.02 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory- fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
1. Two-Bolt Riser Clamps: MSS Type 8.
2. Four-Bolt Riser Clamps: MSS Type 42.

2.03 HANGER-RODS AND ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide galvanized steel hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
1. Steel Turnbuckles: MSS Type 13.
2. Swivel Turnbuckles: MSS Type 15.
3. Malleable Iron Sockets: MSS Type 16.

2.04 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
1. Concrete Inserts: MSS Type 18.
2. Channel Clamps: MSS Type 20.

3. Welded Beam Attachments: MSS Type 22.
4. C-Clamps: MSS Type 23.

2.05 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles and shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

2.06 ROOF CURBS AND PENETRATIONS

A. Prefabricated roof curbs for penetrations shall be provided by this Division. The curbs shall be installed by the general contractor.

2.07 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

2.08 VIBRATION ISOLATION

A. General: Equipment shall be isolated from the structure by means of resilient vibration and noise isolating supports. Supports shall be such that vibration is isolated and expansion and contraction is accommodated without creating excessive stresses in piping or equipment connections.

B. All isolators shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc chromate or metal etching primer. A finish coat of industrial enamel shall be applied over the primer. All isolators exposed to the weather shall have steel parts PVC coated, hot-dipped galvanized or zinc-electroplated plus coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts and washers may be zinc-electroplated.

C. Isolators shall be installed in such a manner that loaded deflections are compensated for initially.

PART 3 EXECUTION

3.01 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure with maximum loading as shown below. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest

pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Provide all fascia boards, cleats, brackets, backing in partitions, toggle bolts, expansion shields, screws, clamps and rods, etc., for hanging of all piping and equipment included under this Division.

C. Hangers and braces shall adequately support the piping system horizontally and vertically and shall allow for expansion and contraction without binding in sleeves or misalignment. Provide for expansion of piping with swing joints and ample sleeves.

D. Vertical Piping: Supports for vertical piping 1-1/2 inches and smaller from wall with malleable split ring hanger. Nipples cut to fit each case. Two hangers per floor, minimum. Use clamps on every floor for pipes 2 inches and larger. In crawl spaces, support stacks on base fitting placed securely on concrete piers or masonry blocks and with pipe clamps.

E. Horizontal piping shall be supported with hangers as follows:

STEEL PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1 inch	3/8 inch	7 feet
1-1/4” inches	3/8 inch	8 feet
1-1/2 inches	3/8 inch	9 feet
2 inches	3/8 inch	10 feet

F. Load carrying capacities of threaded steel rod based on allowable stress of 12,000 psi.

ROD SIZE-INCHES:	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
ALLOW LOAD-LBS:	610	1130	1810	2710	3770	4960	6230	8000

G. Generally, pipes shall be individually supported. Trapeze hangers may be used where approved. Piping shall be individually bolted to trapeze with U bolts.

H. Piping along wall: From approved wall brackets fastened to wall with Phillips anchors or inserts.

I. Installation: Provide pipe bars, angles, etc. as required. Anchor piping to localize expansion and prevent undue strain on piping and branches. Provide spring type hangers for vibration isolation where shown on plans and as specified in vibration isolation section. Locate hanger not more than 4 feet from elbow or tee on screwed piping. Space hangers on 3 foot center on horizontal piping 1-1/2 inch and smaller exposed at corridor ceilings and less than 8 feet from floor in finished rooms.

J. Support from Concrete Construction: All main piping runs shall be supported from hangers secured to cast-in-place concrete inserts. Branch piping hanger supports may be field drilled using self drilling type expansion shields equal to Phillips concrete fasteners or approved equal. Expansion shields shall not cut or unduly displace reinforcement.

K. Support from Precast Concrete: Use toggle bolts mounted in core sections of precast concrete. Absolutely no ramset or any other power driven fasteners will be allowed in precast planks.

L. Support from Existing Concrete: Piping may be attached to the structure using power driven fasteners. All fasteners into concrete shall penetrate the slab for a distance equal to 6 to 8 times the diameter of the shank. Power driven fasteners will not be used in concrete encased steel beams.

M. Support from Structural Steel: Make use of existing steel members for pipe support. Provide additional structural steel members where required to accommodate hangers.

N. Anchors: Anchor piping as shown or required to isolate expansion and prevent pipe strain due to expansion. Anchors shall be separate from other supports.

O. Expansion Joints and Pipe Guides: Install in accordance with manufacturers recommendation. Locate additional guide within recommended distance of the first guide integral to the expansion joint. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated, for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

P. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

3.02 PROVISIONS FOR MOVEMENT

A. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

B. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.03 PIPE EXPANSION

A. Provide pipe expansion products to make allowance for expansion and contraction of pipe. Provide bellows type or flexible expansion loop as required.

B. Insulated Piping: Comply with the following installation requirements.

C. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

D. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields.

3.04 EQUIPMENT SUPPORTS

A. Modify structural steel Stands to support equipment mounted on the roof. Construct of structural steel members to match existing. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Provide shop drawings for structural steel stands for Engineer's approval.

END OF SECTION

SECTION 230530

ELECTRICAL PROVISIONS FOR MECHANICAL WORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-1 Specification sections and other Division 23 specification sections, apply to work of this section.

B. This section is a Division-23 Basic Mechanical section, and is a part of each Division-23 section making reference to electrical provisions of Mechanical work specified within.

1.02 DESCRIPTION OF WORK

A. Extent of electrical provisions to be provided as mechanical work is indicated in other Division-23 sections, on drawings, and as further specified in this section.

B. All work on this project will be done through a single prime contract. All power and control wiring and other electrical work shown is the responsibility of the prime contractor. These include but are not necessarily limited to the following:

1. Motors for mechanical equipment
2. Starters for motors of mechanical equipment whether or not starter is specifically indicated to be furnished with the mechanical equipment. Unless otherwise noted, the mechanical contractor shall provide all motor starters, and combination starters/disconnects required for mechanical equipment. Motors being equipped with adjustable speed drives (ASD's) will not require starters. The contractor will provide the ASD's.
3. All electrical equipment and devices (panels, disconnects, circuit breakers, etc.)
4. All interlock and control wiring required for sequence operation of mechanical devices provided for mechanical systems
5. All power wiring for mechanical equipment and all power and low voltage wiring for the DDC controls
6. Any power wiring required for mechanical equipment not specifically shown on electrical drawings or specified in Division 16

C. Refer to other Division-23 sections for specific individual mechanical equipment electrical requirements.

D. Refer to Division-26 sections for materials and methods of other electrical components of mechanical equipment.

1.03 QUALITY ASSURANCE

A. Coordination with Electrical Work: Wherever possible, match elements of electrical provisions of mechanical work with similar elements of electrical work specified in Division -16 sections. Comply with applicable requirements of Division-16 sections for electrical work of this section which is not otherwise specified.

B. Standards: For electrical equipment and products, comply with applicable NEMA standards, and refer to NEMA standards for definitions of terminology herein. Comply with National

Electrical Code (NFPA 70) for workmanship and installation requirements. Electrical work shall be done in accordance with Codes listed and also requirements of Division 16.

1.04 SUBMITTALS

A. Listing, Motors of Mechanical Work: Concurrently with submittal of mechanical products listing (Basic Mechanical requirements), submit separate listing showing rating, power characteristics, application (connected equipment), and general location of every motor to be provided with mechanical work. Submit updated information promptly when and if initial data is revised.

B. Include in listing of motors, notation of whether motor starter is furnished or installed integrally with motor or equipment containing motor.

PART 2 PRODUCTS

2.01 MOTORS

A. Manufacturer: Except where item of mechanical equipment (which otherwise complies with requirements) must be integrally equipped with motor produced by another manufacturer, provide motors for mechanical equipment manufactured by one of the following:
1. Baldor Electric Co.
2. General Electric Co.
3. Reliance Electric Co.
4. Westinghouse Electric Corp.
5. U.S. Electric Motor Co.

B. Motor Characteristics: Except where more stringent requirements are indicated, and except where required mechanical equipment cannot be obtained with fully complying motor, comply with the following requirements for motors of mechanical work:

C. Temperature Rating: Rated for 40 deg.C environment with maximum 50 deg.C temperature rise for continuous duty at full load. Insulation shall be Class F.

D. Starting Capability: Provide each motor capable of making starts as frequently as necessary by automatic control system, and not less than 5 starts per hour for manually controlled motors.

E. Phases and Current Characteristics: Unless otherwise noted, provide squirrel-cage induction polyphase motors for 2 hp and larger, and provide capacitor-start single-phase motors for 1/3 hp and smaller, except 1/6 hp and smaller may, at equipment manufacturer's option, be split-phase type. Coordinate current characteristics with power specified in Division-16 sections, and with individual equipment requirements specified in other Division-15 requirements. For 2-speed motors provide 2 separate windings on polyphase motors. Unless otherwise noted all polyphase motors shall be suitable for 240 volt, 3 phase, 60 Hz service.

F. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

G. Motor Construction: Provide general purpose, continuous duty motors, Design "B" except "C" where required for high starting torque. For motors controlled by variable speed drives, provide inverter duty motors that comply with NEMA MG1-Part 3 Definite Purpose Inverter-Fed Motors.

H. Frames: NEMA No. 56 or Type T(unless otherwise noted)

I. Bearings: Ball or roller bearings with inner and outer shaft seals, regreasable except permanently sealed where motor is normally inaccessible for regular maintenance.

J. Where belt drives and other drives produce lateral or axial thrust, in motor, provide bearings designed to resist thrust loading. Refer to individual sections of Division 15 for fractional-hp light-duty motors where sleeve-type bearings are permitted.

K. Enclosure Type: Except as otherwise indicated, provide TEFC motors. Refer to individual sections of Division 15 for other enclosure requirements.

L. Overload Protection: Provide built-in thermal overload protection and, where indicated, provide internal sensing device suitable for signaling and stopping motor at starter.

M. Noise Rating: Provide "Quiet" rating on motors.

N. Efficiency: All permanently wired motors of 1 HP or more shall have a nominal full load motor efficiency not less than that required by ASHRAE 90.1. Where specified, provide premium efficiency motors.

O. Name Plate: Provide metal nameplate on each motor, indicating full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

2.02 EQUIPMENT FABRICATION

A. General: Fabricate mechanical equipment for secure mounting of motors and other electrical items included in work. Provide either permanent alignment of motors with equipment, or adjustable mountings as applicable for belt drives, gear drives, special couplings and similar indirect coupling of equipment. Provide safe, secure, durable, and OSHA compliant removable guards for motor drives, arranged for lubrication and similar running-maintenance without removal of guards.

2.03 MOTOR STARTERS

A. Manufacturers: Subject to compliance with requirements, provide motor starters of one of the following (for each type and rating of motor starter):
1. Allen-Bradley Co.
2. Cutler Hammer Products, Eaton Corp.
3. General Electric Co.
4. Square D Co.
5. Westinghouse Corp.

B. General: Except as otherwise indicated, provide motor starters and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation.

C. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

D. Motor Starter Characteristics:
1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations which shall have NEC proper class and division.
2. Manual switches shall have pilot lights and extra positions for multi-speed motors.

E. Overload protection: melting alloy type thermal overload relays.

F. Magnetic Starters:
1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated
2. Trip-free thermal overload relays, each phase
3. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of mechanical equipment Multi-Speed starters shall be provided with integral time delay transition between "FAST" and "SLOW" speeds
4. Built-in 120 volts control circuit transformer, fused from line side, where service exceeds 240 volts
5. Externally operated manual reset
6. Under-voltage release or protection

G. Motor Connections:
1. Liquid-tight flexible conduit, except where plug-in electrical cords are specifically indicated.

H. Combination Non-Reversing Starters: Provide full voltage alternating-current combination non-reversing starters, consisting of starter and disconnect switch mounted in common enclosure, of types, sizes, ratings, and NEMA sizes as required. Equip starters with electrical interlocks for interfacing with other starters. Equip starters with block type manual reset overload relays and with fusible disconnect switches.

I. Provide operating handle for disconnect mechanism with indication and control of switch position, with enclosure door either opened or closed, and capable of being padlocked in OFF position. Construct and mount starters and disconnect switches in single NEMA Type 1 enclosure: coat with manufacturer's standard color finish.

J. AC Fractional HP Manual Starters: Provide single-phase fractional HP manual motor starters, of sizes and ratings required. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Starter to become inoperative when thermal unit is removed. Provide starters with double break silver alloy contacts, visible from both sides of starter; green pilot lights, and switch capable of being padlocked OFF. Enclose starter unit in NEMA Type 1 general purpose enclosure suitable for flush mounting; coat with manufacturer's standard color finish.

2.04 WIRING

A. Low voltage wiring shall be no. 18 rubber covered, color coded wire or cable. Line voltage wiring shall be not smaller than #12 600 volt wire. All wire shall be run in rigid conduit with outlet boxes and fittings in a manner comparable to that specified in the electrical specifications. All ground wire shall be THHN for line voltage. All wire will be pulled to every pump, disconnect, starter motor etc. Conduit shall not be used as ground.

2.05 DISCONNECTS

A. Non-Fused.
1. Wall mounted, standard duty, single throw in NEMA-l enclosure or NEMA 3R enclosure, weatherproof for exterior locations. Single-pole or three-pole as required with solid neutral. External handle lockable in the open position. Disconnect switches shall be provided wherever the code requires local disconnecting means.
2. Make: Square D, General Electric or Westinghouse.

B. Fused Disconnect Switches
1. Single throw, quick-make, quick-break: Number of poles as required by load.

NEMA-1 general purpose enclosure indoors in dry locations, NEMA 3R weatherproof enclosure outside. Standard fuse clips, lockable in open position. Rating 250 or 600 VAC as required.

2. Make: General Electric, Square D, Westinghouse.

2.06 MOLDED CASE CIRCUIT BREAKERS (MCCB):

A. Manufacturers: Subject to compliance with requirements, provide MCCB's of one of the following:
1. Cutler-Hammer/Westinghouse
2. General Electric
3. Siemens
4. Square D

B. General: MCCB's shall be industrial grade (bolt-on) with ratings and special features as scheduled on drawings. Trips shall be thermal magnetic with inverse time delay and instantaneous time-current characteristics. 225 ampere frame and larger MCCB's shall have interchangeable trips and adjustable magnetic feature. MCCB's used outdoors shall have ambient compensating trips. MCCB's used for switching lights shall be rated for switching duty and shall be so labeled. MCCB's used for overcurrent protection for HVAC equipment shall be rated "HACR" type and shall be so labeled. MCCB's to be installed in existing panelboards shall be of the same manufacturer as the panelboard. Ganged use of single-pole breakers for multi-pole applications is not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 hp and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts.

B. Install motor starters, in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to insure that products fulfill requirements.

C. Coordinate with other work including motor and electrical wiring/cabling work, as necessary to interface installation of motor starters with other work.

D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A.

3.02 ADJUSTING AND CLEANING

A. Inspect electrical starter's operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.03 FIELD QUALITY CONTROL

A. Subsequent to connecting wires/cables, energize motor starter circuitry and demonstrate functioning of equipment in accordance with requirements; where necessary correct malfunctioning units, and then retest to demonstrate compliance. Ensure that direction of rotation of each motor fulfills requirements.

END OF SECTION

SECTION 230550

VARIABLE SPEED DRIVES

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. All work of this Division shall comply with the requirements of the Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division 1 Specification Sections.

B. Section 15010 - General Provisions.

C. Section 15030 - Electrical Provisions of Mechanical Work

D. Division 16 - Electrical

1.02 RELATED SECTIONS

A. Division 16 - Electrical Identification: Engraved nameplates.

1.03 REFERENCES

A. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

B. NEMA - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. CSA Approved

D. IEEE Standard 444 (ANSI-C343)

E. IEC: 146A

1.04 SUBMITTALS

A. Submit under provisions of Section 01340.

B. Shop drawings shall include; wiring diagrams, front and side views of enclosures, overall dimensions, conduit entrance locations and requirements, nameplate legends, and enclosure details.

C. Product Data: Provide data sheets showing; voltage, ratings and size of switching and overcurrent protective devices, short circuit ratings, and weights.

D. Manufacturer's Installation 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 adjustable speed drive.

1.05 QUALITY ASSURANCE

A. ASD shall have a minimum MTBF (mean time between failure) rating of 100,000 hours.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 15010.

B. Include instructions for starting and operating ASD, and describe operating limits, that may result in hazardous or unsafe conditions.

1.07 QUALIFICATIONS

A. Manufacturer must have a minimum of 10 (ten) years documented experience, specializing in adjustable speed drives.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site, under provisions of Section 15010.

B. Accept ASD on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping, or provide an additional heavy canvas or heavy plastic cover, to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully, in accordance with manufacturer's written instructions, to avoid damage to components, enclosure, and finish.

1.09 WARRANTY

A. Provide ASD warranty for three years from date of final acceptance. Warranty shall include parts and labor.

1.10 WORK INCLUDED

A. Provide adjustable speed drives for the following equipment. See mechanical schedules for motor sizes and voltages.
   1. Secondary chilled water pump
   2. Marteena pump

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ASD shall be manufactured by Graham, ABB, Square D, Bell & Gossett, or prior approved alternate. All ASDs on the project shall be by the same manufacturer.

2.02 DESCRIPTION

A. Provide enclosed adjustable speed drives suitable for operating at the current, voltage, and horsepower indicated on the plans. Conform to requirements of NEMA ICS 3.1.

2.03 RATINGS

A. ASD must operate at full output, without fault or failure, when voltage varies plus or minus 10 percent from rating, and frequency varies plus or minus 2 percent from rating.

B. ASD must not be damaged when an open circuit is introduced on the output of the ASD while the drive is actively controlling a motor or device.

C. ASD shall be 60 Hz, voltage as indicated on the plans.

D. Displacement Power Factor: 0.98 over entire range of operating speed and load.

E. Operating Ambient Temperature: -10°C. to 40°C. (14°F. to 104°F.)

F. Humidity: non-condensing to 90%.

G. Altitude: to 3300 feet, higher by derating.

H. Minimum Efficiency: 96% at half speed; 98% at full speed.

I. Starting Torque: 100% starting torque shall be available from 0.5 Hz. to 60 Hz.

J. Overload capability: 110% of rated F.L.A. (full load amps) for 60 seconds; 160% of rated F.L.A., for 0.5 seconds.

K. The ASD must meet the requirements for Radio Frequency Interference (RFI) above 7 MHz as specified by FCC regulations, part 15, subpart J, Class A devices.

L. In compliance with IEEE 519, the Total Harmonic Distortion for the ASD shall be no greater than 5%. When the THD is above 5% the supplier of the ASD shall provide line reactors.

M. The ASD provided must be capable of outputting up to a 70hz signal

2.04 DESIGN

A. ASD shall employ microprocessor based inverter logic.

B. Control circuit shall be isolated from all power circuits.

C. ASD shall include surface mount technology, with conformal coating.

D. ASD shall employ a PWM (pulse width modulated) inverter system, consisting of:
   1. Input Section:
      a. ASD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid state full wave diode rectifier.
   2. Intermediate Section:
      a. DC bus as a supply to the ASD Output Section shall maintain a fixed voltage with filtering and short circuit protection.
      b. DC Bus shall be interfaced with the ASD diagnostic logic circuit, for continuous monitoring and protection of the power components.
   3. Output Section
      a. Insulated gate bipolar transistors (IGBT's) shall convert DC bus voltage to

variable frequency and voltage.

b. PWM sine coded output to the motor.

E. The ASD shall have D.C. link reactors on both the positive and negative rails of the D.C. bus to minimize power line harmonics. ASD without D.C. link reactors shall provide a minimum 3% impedance line reactor.

F. ASD shall be rated for 100,000 amp interrupting capacity (AIC).

G. The ASD must be amp rated at carrier frequencies at or above 10 kHz. Exception to this requirement is allowed only for ASDs providing 104 amps or more.

H. The ASD must be selected for operation at carrier frequencies at or above 10 kHz to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule.

I. ASD shall have an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and ASD efficiency while reducing noise.

J. ASD shall include two independent remote reference inputs. One shall be 4-20 ma. The other shall be 0-10 VDC. Either input shall respond to a programmable bias and gain.

K. ASD shall include a minimum of three multi-function input terminals, capable of being programmed, to determine their function when their state is changed. These terminals shall provide up to 20 functions, including, but not limited to:

1. Remote/Local operation selection.
2. Detection of external over-heat condition.

L. ASD shall include a 0-10V DC analog output, proportional to frequency or current, for either monitoring, or "speed tracking" the ASD.

M. ASD shall provide terminals for remote contacts, to allow starting in the automatic mode.

N. ASD shall include at least one external fault input, which shall be programmable, for either a normally open, or a normally closed contact, for connection to firestats, freezestats, etc.

O. ASD shall include a minimum of three multi-function output terminals, one of which shall be a fully rated form "C" contact, capable of being programmed, to determine what conditions must be met, in order for them to change their state. These terminals shall provide up to 15 functions, including, but not limited to:

1. Zero speed detection.
2. Low and high frequency detection.
3. Missing frequency reference detection.
4. Overtorque detection

P. ASD shall include a power loss ride thru of 2000 milliseconds (2 seconds).

Q. ASD shall be capable of restarting automatically after a power failure.ASD shall include a front mounted, sealed keypad operator, with a digital display, to provide complete programming, operating, monitoring, and diagnostic capability. Keys provided shall include commands for RUN, STOP, and RESET. Operating mode (auto or manual) and speed setting functions shall also be provided. Keypad may be of the removable type.

R. ASD display shall provide readouts of; output frequency in hertz, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminal status, and fault codes.

S. ASD shall be capable of PID (Proportional, Integral, Derivative) logic, to provide closed-loop setpoint control capability, from a remote reference.

T. ASD shall include loss of input signal protection, with a speed default to 80% of the most recent speed.

U. ASD shall include electronic thermal overload protection for both the drive and motor, profilable for variable or constant torque.

V. ASD shall include the following programming functions:
1. Critical frequency rejection capability: 3 selectable, adjustable bands
2. Auto restart capability: 0 to 10 attempts
3. Stall prevention capability
4. "S" curve soft start capability
5. "Speed search" capability, in order to start a rotating load
6. 15 preset volts per hertz patterns
7. One adjustable volts per hertz pattern
8. Current limit adjustment capability, from 30 % to 200 % of rated full load current of the ASD
9. Anti "wind milling" function capability

W. ASD shall include factory settings for all parameters, and the capability to be reset back to those settings.

X. ASD shall include the capability to adjust the following functions, while the ASD is running:
1. Acceleration adjustment from 0 to 600 seconds
2. Deceleration adjustment from 0 to 600 seconds
3. A minimum of three different preset speeds
4. Analog output gain, to calibrate the signal for the application used

Y. Manual Bypass shall be provided. ASD and bypass components shall be mounted in a side-by-side arrangement, inside a common NEMA 1 enclosure, fully pre-wired, and ready for installation as a single UL listed device. Bypass shall include the following:
1. Input, output, and bypass contactors, to disconnect power to the ASD when the motor is running in the bypass mode
2. 115 V.A.C. control transformer, with fused primary
3. Thermal overload relay, to protect the motor while operating in the bypass mode
4. Fused disconnect switch
5. Control and safety circuit terminal strip
6. "Drive-Off-Bypass-Test" selector switch
7. Pilot lights for "Power On", "Running On Drive", "Running On Bypass" and "Fault"

2.05 PRODUCT OPTIONS

A. Current limiting, fast acting input fusing, for the protection of ASD semiconductor devices.

B. Serial communications gateway, for either RS-232 or RS-485, to provide interface from an ASD to; a computer, a Program Logic Controller (PLC), or Building Automation System, for

those units which need to interface with such.

C. PID EPROM for those units which shall be controlled directly by pipe or duct static pressure sensors.

2.06 FABRICATION

A. Enclosure: NEMA Type 1 for indoor pump application, NEMA 3R for cooling tower.

2.07 SOURCE QUALITY CONTROL

A. In-circuit testing of all printed circuit boards shall be conducted, to ensure the proper mounting and correct value of all components.

B. All printed circuit boards shall be burned in for 96 hours, at 85°C.

C. Final printed circuit board assemblies shall be functionally tested, via computerized test equipment. All tests and acceptance criteria shall be preprogrammed. All test results shall be stored as detailed quality assurance data.

D. All fully assembled controls shall be functionally tested, with fully loaded induction motors. The combined test data shall then be analyzed, to insure adherence to quality assurance specifications.

E. Inspect and production test, under load, each completed ASD assembly.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surface is suitable for ASD installation.

B. Do not install ASD until the building environment can be maintained, within the service conditions required by the manufacturer.

3.02 INSTALLATION

A. Install ASD where indicated, in accordance with manufacturer's written Instructions and NEMA ICS 3.

B. Tighten accessible connections and mechanical fasteners after placing ASD.

C. Provide neatly typed label on each ASD, identifying nameplate horsepower, full load amperes, model number, service factor and voltage/phase rating.

D. Where a disconnect is provided between the ASD and the controlled equipment, provide a contactor to turn off ASD when the disconnect is opened.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing to be performed under provisions of Section 15010.

B. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.04 MANUFACTURER'S FIELD SERVICES

A. Provide factory trained and authorized startup technician to startup, tune, and test ASD and its interface to the building automation system.

3.05 ADJUSTING

A. Adjust work under provisions of Section 15010. Make final adjustments to installed ASD to assure proper operation of systems.

3.06 TRAINING

A. In addition to initial startup, provide a minimum of two (2) hours of training for the physical plant staff in the startup, operation, adjustment, and troubleshooting of the ASD. Provide written certification of the training with the signatures of the attendees.

END OF SECTION

SECTION 230590

MECHANICAL PAINTING AND IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-01 Specification sections and other Division 23 specification sections, apply to work of this section.

1.02 SCOPE

A. Paint and/or identify the following:
1. All mechanical equipment
2. All electrical equipment, including panels
3. Control panel and control components including control dampers
4. CHW, HW, and dual temperature supply and return piping
5. Domestic water piping
6. Structural Steel
7. Duct Supports

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data and installation instructions.

PART 2 PRODUCTS

2.01 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid, snap-on, color-coded pipe markers, complying with ANSI A13.1. Provide full-band pipe markers, extending 360 degrees around pipe at each location.

B. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Engineer in cases of variance with name as shown or specified.

C. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.02 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp- engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 2" high, and with 5/32" hole for fastener.

B. Provide 1-1/2" diameter tags, except as otherwise indicated.

C. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.03 ENGRAVED PLASTIC-LAMINATE SIGNS AND EQUIPMENT MARKERS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes indicated, 1/16" thick, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Fasteners: Self-tapping stainless steel screws.

PART 3 EXECUTION

3.01 PAINTING

A. All equipment, except where otherwise specifically noted, shall be furnished in prime coat. All un-insulated black steel piping shall be prime coated and finish painted in light gray unless otherwise required by schedule below to be color coded. All welds, on both insulated and un-insulated piping, shall be painted with one coat of primer. All miscellaneous black steel items such as hangers and rods, machinery supports, breechings and stacks, etc., shall be prime coated and finish painted in light gray. Exposed surfaces of insulation shall be sealed. All metal surfaces shall be thoroughly cleaned of rust and dirt and shall be degreased before application of primer. All prime coated equipment shall be touched up where prime coats are chipped, scratched, or otherwise damaged. All prime coated equipment shall be thoroughly cleaned and left ready for finish painting. Where cast iron accessories or galvanized pipe, or equipment surfaces are to receive finish painting, the item shall be properly primed.

B. Ferrous surfaces shall be painted with the following coats:
1. 1 coat of primer equivalent to Bruning Silathane 520-14 grey-green primer, Benjamin Moore 06- 20 red oxide alkyd primer or Richards SR-1399 red metal primer.
2. 2 coats of finish equivalent to Bruning Silathane Gloss Enamel 520-32 quarry gray, Benjamin Moore Gloss Enamel 22-38 or Richards Gloss Enamel 1003 Series.

C. Finish painting of all equipment and piping (both insulated and uninsulated) shall be provided. Where indicated or specified, existing equipment, piping, duct, etc. shall be cleaned and painted along with new work. Do not paint piping that is provided with aluminum or PVC jacketing insulation covering. Paint piping insulation per color schedule below and provide stenciled identification or plastic pipe markers.

D. Painting and/or identification shall be in accordance with the following schedule:

ITEM	IDENTIFICATION	PIPE COLOR
Heating Hot Water	HHWS, HHWR	
Burgundy		
Chilled Water	CHWS, CHWR	Royal Blue
Condenser Water	CWS, CWR	Light Green
Dual Temperature Water	DTS, DTR	Yellow
City Water	City Water	Green
Steam (Low, Medium, or High Pressure)	LPS, MPS or HPS	Orange

Condensate	Condensate	Burgundy
Heat Exchangers	Hex	Light Gray
Natural Gas	Nat. Gas.	Yellow

E. All other uninsulated ferrous pipes shall be painted light gray with stenciled identification as specified under stenciling.

3.02 GENERAL MECHANICAL IDENTIFICATION

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces. Install identification after completion of covering and painting.

3.03 PIPING SYSTEM IDENTIFICATION

A. Install plastic pipe markers on each system indicated to receive identification.

B. Locate pipe markers and color bands as follows:
1. Near each valve and control device
2. Near each branch
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment and in mechanical rooms

C. Stenciling: In lieu of plastic pipe markers, stenciling may be used for identification. Apply stenciling after finished painting has been completed. Stencil indication shall be in block letters, applied with black paint (except white paint on black surface) Stencil as follows:

OD Pipe or Covering	Stencil Letter Size
3/4 in. thru 1-1/4 in.	2 in.
1-1/2 in. thru 2 in.	3/4 in.
2-1/2 in. thru 4 in.	1 in.
6 in. and larger	2 in.

D. All underground lines shall have a magnetic type warning tape installed in the backfill at least six inches below grade.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in typed valve schedule for each piping system, and post under glass in main mechanical room and/or boiler room.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Roof Top Units.

2. Main control and operating valves, including safety devices.

END OF SECTION

SECTION 230700

MECHANICAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-1 Specification sections and other Division 23 specification sections, apply to work of this section.

1.02 RATING

A. All insulation systems, including jackets and adhesives shall be U.L. rated and FM approved. All insulation for indoor use shall have a maximum permanent flame spread rating of 25 or less and a smoke developed rating of 50 or less, as tested by ASTM E 84 (NFPA 255) method. Outdoor mechanical insulation may have flame spread index of 75 and smoke developed index of 150. Submit smoke and flame ratings for every material proposed for use.

B. Make: Certain Teed, Owens Corning, Johns Manville, Knauf and PPG.

1.03 SCOPE

A. Furnish and install insulation for the following: Note scope varies depending on alternates selected.
1. All supply air ductwork.
2. Return air ducts in unconditioned spaces (outside ceiling spaces, duct chases, mechanical rooms, etc.).
3. Refrigerant lines for heat pump system. Exterior piping to have aluminum jacket
4. CHW, HW, dual temp, and domestic water piping.

1.04 QUALITY ASSURANCE

A. Insulation contractor shall be member of either the National Insulation Association (NIA) or the Southeastern Insulation Contractors Association (SEICA).

1.05 SUBMITTALS

A. Submit evidence of membership in NIA or SEICA.

B. Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

C. Submit, if requested by Designer, manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

PART 2 PRODUCTS

2.01 Type 1: Thermal Pipe Insulation with Jacket. Preformed Fiberglass Pipe insulation complying

with ASTM C547, Class 3, rigid, molded pipe insulation, noncombustible. Maximum K-factor of .24 at mean temperature of 75F. All insulation shall have a jacket of white kraft paper reinforced with a glass fiber yarn and bonded to an aluminum foil, with self sealing longitudinal laps and butt strips. Jacket shall comply with ASTM C1136 (Type 1). Insulation and jacket shall be equal to Johns Manville Micro-Lok with AP-T Plus.

2.02 Insulate all fittings, valves and strainers with molded fittings, mitered segments of pipe insulation or over- sized pipe insulation held in place with wire. Finish in accordance with manufacturer's recommendations to comply with the UL Systems listing. Preformed jackets of PVC material as manufactured by Zeston, Inc., may be used at fittings.

A. Type 2: Flexible Pipe Insulation:
1. Material – Flexible, closed cell, elastomeric thermal insulation, maximum k value .27 at 75 degrees F. conforming to ASTM C 534.
2. Fittings - Sleeve type fitting covers and miter cut tubular form.
3. Insulation Adhesive – As recommended by manufacturer.

Make: Armstrong AP Armaflex, Rubatex No. R-180-J, or approved equal.

2.02 FIELD APPLIED JACKETS

A. PVC Plastic: Zeston 2000 or equal. One piece molded type fitting covers and jacketing material, gloss white.

B. Canvas Jacket: UL listed fabric, 6 oz/sq yd, plain weave cotton treated with dilute fire retardent lagging adhesive.

C. Aluminum Jacket: 0.016 inch thick sheet, corrugated finish, with longitudinal slip joints and 2 inch laps, die shaped fitting covers with factory attached protective liner.

D. Stainless Steel Jacket: Type 304 Stainless steel, 0.10 inch, corrugated finish.

2.03 TYPE 1 PIPE INSULATION THICKNESS

A. Insulate hot and chilled water pipe and condensate drain pipe sizes with wall thicknesses as indicated in the following table. Dual temperature piping to be insulated the thicker

	1 1/2" and smaller	1 1/2" to 2"	2 1/2" to 4"	5" and larger	Runouts up to 2" diameter and 12' long
Hot Water or dual temperature	1 1/2"	2"	2"	2" or larger	1-1/2"
Chilled Water	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1-1/2"
Condensate	1/2"	1/2"	1"	-	1/2"
Make-up Water	1"	1"	1"	1"	-

2.04 TYPE 2 PIPE INSULATION THICKNESS

A. Insulate hot and condensate drain and refrigerant piping wall thicknesses as indicated in the following table.

	1” and smaller	1 1/4” to 2”	Runouts 2” diameter and greater
Refrigerant	1/2”	1/2 ”	1/2”
Chilled Water	1”	1”	1”
Condensate	1/2”	1/2”	

2.05 DUCT INSULATION

A. Type A - Vapor Seal Duct Insulation

1. Material: Fiberglass duct wrap 1 lb. density with FSK facing complying with ASTM C1290. Maximum K-factor of .31 at 75ºF. Jacket shall be FSK aluminum foil reinforced with fiber glass yarn and laminated to fire resistant kraft paper, secured with UL listed pressure sensitive tape and outward clinch expanding staples and vapor barrier mastic. Johns Manville Microlite or equal by Owens Corning or Knauf.
2. Thickness shall be 2 inches.

B. Type B - Vapor Seal Duct Insulation - Rigid

1. Fiberglass ductboard complying with ASTM C612, Type I. 3 lb. density, with maximum K-factor of 0.23 at 75ºF mean temperature. Jacket shall be FSK aluminum foil reinforced with fiber glass yarn and laminated to fire resistant kraft paper, secured with UL listed pressure sensitive tape and outward clinch expanding staples and vapor barrier mastic. Johns Manville 800 or equal by Owens Corning or Knauf.

C. Type E - Acoustic Insulation

1. Ductliner complying with ASTM C1071. Made from inorganic glass fiber, min. NRC 0.85, 1- inch thick, minimum R-value of 4.0. Johns Manville Permacote Linacoustic or equal by Owens Corning or Knauf.
2. The air stream surface shall have a 100% coverage coating of acrylic polymer formulated with an immobilized EPA registered anti-microbial agent proven resistant to microbial growth as determined by ASTM G21 and G22.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. All insulation shall be applied by experienced pipe coverers and journeymen in accordance with best trade practice. Work shall be as recommended by manufacturer's latest printed installation directions. Test, inspect, and clean all surfaces to be insulated before applying insulation. Take all possible precautions to protect work of other trades. Provide protective covering as required to accomplish this and be responsible for returning all equipment and material to its original new condition and appearance where damage occurs due to neglect.

B. For refrigerant suction piping saddle shall be integral with precompressed, 12 to 20 percent density fiberglass segment as manufactured by Insul coustic.

C. Where subjected to freezing, insulate piping with double the thickness specified in this section.

D. Apply adhesive to exposed risers to prevent slipping and turning.

E. Butt covering neatly to walls, floors, ceiling. Apply bands at end and position so band covers gap between surface and insulation where exposed.

F. At butt ends of insulation the jacket material shall be pulled over exposed ends and secured with bands to give a neat and finished appearance. Exposed fiberglass material will not be permitted.

G. In location where it will be exposed to view do not apply insulating cement until there is heat on lines.

H. Do not cover nameplates on equipment.

I. Do not insulate vibration eliminators.

J. Insulation on all cold surfaces must be applied with a continuous, unbroken vapor seal. Any hangers, supports, anchors, etc. that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. Seal pipe terminations every four sections using Foster 30-35 or equal by Miracle or Mon-Eco Industries, Inc.

K. Owner will select color from chart offered by manufacturer. Provide aluminum jacket on all exterior piping. Provide canvass jacket in mechanical rooms on all new and existing piping.

L. Insulation on piping below ground shall receive 15# felt paper wired every 12" O/C with 18 ga. Stainless steel wire. Felt paper shall be coated with an asphalt-based vapor and weather barrier equal to Chil-Pruf (CP-22/23/24) insulation coating manufactured by Childers Products Company, Inc. Felt and insulation coating shall continue for two feet where pipe comes up above ground. Overlap aluminum jacket over the above-ground vapor barrier.

3.03 PIPE INSULATION SHALL BE APPLIED AS FOLLOWS

A. Type 1 - Thermal Pipe Insulation with Jacket.
1. Hot water, CHW, dual temp, and domestic water, piping installed above ground and inside building.

B. Type 2 - Flexible Pipe Insulation
Refrigerant lines, exterior CHW piping
Condensate piping and runout piping at contractor's option

3.04 DUCT INSULATION SHALL BE APPLIED AS FOLLOWS

A. Type A - Vaporseal Duct Insulation.
1. All new concealed supply air ducts inside the building.
2. All concealed return air ducting.

B. Type B - Vapor Seal Duct Insulation - Rigid.
1. Outside air and supply air ducts located in the mechanical room. Provide canvass jacket.

C. Type E- acoustical liner
1. where specifically called for on the drawings

3.05 SPECIFIC REQUIREMENTS

A. Type A Insulation Fiberglass duct wrap insulation shall be applied over clean, dry sheet metal duct. Before applying the insulation all joints and seams shall be sealed air tight. Duct wrap shall be installed to allow maximum fullness at corners. Minimum thickness at corners is one inch. Insulation shall be butted tightly at joints and vapor barrier facing shall be overlapped

at minimum of 2 inches. Insulation shall be butted tightly at joints and vapor barrier facing shall be overlapped at minimum of 2 inches. Insulation should be removed from lap prior to stapling. All seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with a foil vapor barrier tape, or vapor barrier mastic. Where ducts are over 24 inches in width, the duct wrap shall be additionally secured to the bottom of rectangular ducts with mechanical fasteners spaced on 18 inch centers (maximum), to prevent sagging of insulation. Seal penetrations so as to provide a vapor-tight system.

B. Insulation shall be installed according to manufacturer recommendations. Insulation over the expansion joint and the flexible section shall be loose and of adequate length to permit the movement of pipe.

C. Provide insulation shield equivalent to Fee and Mason Fig. 81 at each support.

3.05 DO NOT INSULATE

A. Vibration eliminators.

END OF SECTION

SECTION 232010

WATER PIPING SYSTEMS AND HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

B. Related Sections
1. Section 019113 General Commissioning Requirements
2. Section 230800 HVAC Commissioning Requirements

1.02 QUALITY ASSURANCE

A. Codes and Standards:
1. ASME Compliance: Fabricate and install water piping in accordance with ASME B31.9 "Building Services Piping".

PART 2 PRODUCTS

2.01 GENERAL

A. Provide pipes and pipe fittings complying with Section 15060 in accordance with the following listings.

B. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.

2.02 BASIC PIPES AND PIPE FITTINGS

A. Heating Hot Water, Chilled Water, and Condenser Water Piping
1. Pipe Size 1 1/2" and smaller: Type “L” copper, hard drawn wrought copper fittings, solder joints.
2. Pipe Size 2": Type “L” copper, hard drawn wrought copper fittings, silver brazed joints.
3. Pipe Size 2 1/2" and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings with welded joints.

B. Condensate Drain Piping:
1. PVC schedule 40

2.03 VALVES

A. Provide valves complying with Section 15100 as follows:
1. Sectional Valves:
   a. 2-1/2" and Smaller: Full Port Ball valves.
   b. 3" and Larger: Butterfly valves.
2. Shutoff Valves:

a. 2-1/2" and Smaller: Full Port Ball valves.
b. 3" and Larger: Butterfly valves.

3. Drain Valves: 2" and Smaller: Standard port, hose end Ball valves.
4. Check Valves: All Sizes: Swing or wafer check valves.

2.04 SPECIAL DUTY VALVES

A. Calibrated Plug Valves (Circuit Setter): 125 psig water working pressure, 250 deg F maximum operating temperature, bronze body, plug valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2 inch and smaller shall have threaded connections and 2-1/2 inch and larger valves shall have flanged connections.

B. Pump Discharge Valves (Triple Duty Valve): 175 psig working pressure, 250 deg F maximum operating temperature, cast-iron body, bronze disc and seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have flanged connections and straight or angle pattern as indicated. Features shall include non-slam check valve with spring-loaded weighted disc, and calibrated adjustment feature to permit regulation of pump discharge flow and shutoff. The valve design shall permit repacking under full system pressure. Valves shall be sized to provide between 1 psi and 3 psi pressure drop when fully open at full flow.

C. Pressure Reducing Valves: Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment.

D. Automatic Flow Control Valves: 250 psig working pressure, brass valve body, stainless steel spring, nickel plated brass piston assembly, “O” ring-style union, ± 5% accuracy, pressure/temperature port on inlet side of spring, ball shutoff valve, Flow Design Model FV or equal.

E. Coil Strainer Valve Assembly: 250 psig working pressure, brass body, basket type strainer with 20 mesh 316 stainless steel screen, “O” ring-style union, pressure /temperature port on outlet side of strainer, ball shutoff valve, Flow Design Model SV or equal.

F. Backflow Preventer: The backflow preventer shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. The relief valve shall contain a separate means where by free air will enter the zone and contained water will be discharged to atmosphere when the valve is fully open. The assembly shall include two tightly closing shut-off valves before and after the device, test cocks and a protective strainer upstream of the first gate valve. The device shall meet the requirements of A.S.S.E. Std. 1013 AEEA Std. C506-78.

G. Safety Relief Valves: 150 psig working pressure and 250 deg F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber. Select valve to suit actual system pressure and Btu capacity.

H. Pressure Vessel Code. Valve body shall be cast iron, with all wetted internal parts made of brass and rubber. Select valve to suit actual system pressure and Btu capacity.

2.05 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 225 deg F operating temperature; manually operated with ball valve; above ceilings it shall and having 1/8 inch discharge connection and inch inlet connection, with outlet pointed down at convenient location for draining. In mechanical rooms it shall be ½" copper pipe, piped down wall with ball valve 3' off floor, and pipe to drain.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240 deg F operating temperature; and having 1/4 inch discharge connection and inch inlet connection, with outlet pointed down at convenient location for draining.

C. Expansion Tank (BLADDER Type): Size and number as indicated; Pre-charged steel expansion tank with replaceable heavy duty Butyl rubber bladder. The tank shall have a 1 inch NPT system connection, ¾ inch drain, and a .302-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped 125 PSI working pressure. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation.

D. Air Separator: Welded black steel; ASME constructed and labeled for minimum 150 psig water working pressure and 375 F operating temperature; perforated stainless steel air collector tube designed to direct released air into compression tank; tangential inlet and outlet connections; screwed connections up to and including 2" NPS; flanged connections for 2-1/2" NPS and above; threaded blowdown connection; sized as indicated for full system flow capacity. Unit shall have a removable stainless steel system strainer with 3/16" diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe.

E. Pump Suction Diffusers: Cast-iron body, with threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger; 175 psig working pressure, 300 deg F maximum operating temperature; and complete with the following features:

F. Chemical Feeder: Bypass type chemical feeders of 2 gallon capacity, welded steel construction; 125 psig working pressure; complete with fill funnel and inlet, outlet, vent and drain valves. Chemicals shall be specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, developed based on a water analysis of make-up water.

G. Y-Pattern Strainers: 125 psig working pressure cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, bolted cover, perforated Type 304 stainless steel basket, and bottom drain connection.

H. Basket Strainers: 125 psig working pressure; high tensile cast-iron body (ASTM A 126, Class B), flanged end connections, bolted cover, perforated Type 304 stainless steel basket, and bottom drain connection.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING

A. Install eccentric reducers where pipe is reduced in size in direction of flow, with tops of both pipes and reducer flush.

B. Install supply piping with 1/32" per foot (1/4%) downward slope in direction of flow.

C. Install return piping with 1/32" per foot (1/4%) downward slope in direction of flow.

D. Connect branch-feed piping to mains at horizontal center line of mains. Connect run-out piping to branches at horizontal center line of branches.

E. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

F. Provide manual air vents at system high points.

3.02 INSTALLATION OF VALVES

A. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more hydronic terminals or equipment connections, and elsewhere as indicated.

B. Shutoff Valves: Install on inlet and outlet of each mechanical equipment item, and on inlet of each hydronic terminal, and elsewhere as indicated.

C. Drain Valves: Install on each mechanical equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain hydronic piping system.

D. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

E. Relief Valves: Install relief valves on low side of reducing valves and expansion tanks. Pipe relief-valve outlet to the nearest floor drain.

3.03 EQUIPMENT CONNECTIONS

A. Connect piping to mechanical equipment as indicated, and comply with equipment manufacturer's instructions where not otherwise indicated. Install shutoff valve and union on supply and return, drain valve on drain connection. Install full port ball valves for all connections of ferrous pipe to non-ferrous pipe.

3.04 INITIAL CLEANOUT

A. After system checkout, cleanout entire system prior to extended operation. This cleanout operation shall include replacement of all disposable strainers and cleaning of all strainers and dirt legs. Provide all necessary chemicals for initial cleanout based on equipment manufacturer’s recommendation. Refer to Section 15515 for additional requirements.

B. After initial cleanout is complete, set up all systems with required amounts of chemicals based on the water analysis of make-up water as previously indicated for bypass feeders. Remove start up strainers. Blow down strainers in coordination with engineer. Leave start up strainers for owner’s inspection.

END OF SECTION

SECTION 232123

HVAC PUMPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. HI Compliance: Design, manufacture, and install HVAC pumps in accordance with HI "Hydraulic Institute Standard".

B. UL Compliance: Design, manufacture, and install HVAC pumps in accordance with UL 778 "Motor Operated Water Pumps".

1.03 SUBMITTAL

A. Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

PART 2 PRODUCTS

2.01 FLEXIBLE COUPLED END SUCTION PUMPS

A. Pumps shall be base-mounted, single-stage, and end suction design with true back pull-out, capable of being serviced without disturbing piping connections, pump volute or motor.

B. Pump and motor shall be coupled with a drop-out spacer coupling capable of absorbing torsional vibration. The spacer shall be removable without disturbing the pump volute or the motor. An ANSI/OSHA compliant coupling guard shall completely enclose the coupling and rotating shaft.

C. Pump volute shall be cast iron with integrally-cast pedestal support. The impeller shall be cast bronze, enclosed-type, dynamically balanced, keyed to the shaft and secured by a locking cap-screw.

D. The liquid cavity shall be sealed off at the pump shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 250 deg. F. A replaceable bronze shaft sleeve shall completely cover the wetted area under the seal. A stuffing box or externally flushed mechanical seal design with longer span between impeller centerline and first bearing centerline will not be allowed.

E. Pumps shall be rated for a minimum of 175 psi working pressure. Casings shall have gauge ports at nozzles and vent and drain ports at top and bottom of casing.

F. Pump bearing housing assembly shall have heavy-duty regreasable ball bearings, replaceable without disturbing piping connections, pump volute or motor, and, have foot support at

coupling end.

G. Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area. Contractor is to level and grout each unit according to manufacturer's instructions.

H. The motor shall meet NEMA specifications and shall be the size, voltage, enclosure, and efficiency called for on the plans and in section 15030.

I. Pump and motor shall be factory aligned, and shall be realigned by contractor after installation.

J. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.

K. Each unit shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to the pump for owner's reference.

L. End suction pumps shall be Series "1510" as manufactured by ITT Bell and Gossett or approved equal by Taco or Armstrong.

2.02 IN-LINE CIRCULATING PUMPS

A. Pumps shall be in-line type for installation in vertical or horizontal piping. Pump shall be capable of being serviced without disturbing piping connections.

B. Pump body shall be of Class 30 cost iron, rated 175 psi working pressure, with gauge ports at nozzles, and with vent and drain ports. Pumps shall have suction and discharge sizes as scheduled.

C. Impeller shall be non-ferrous material, enclosed type, dynamically balanced, keyed to the shaft and secured by a locking capscrew or nut.

D. The liquid cavity shall be sealed from the pump bearing by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 250 deg. F. A non-ferrous shaft sleeve shall completely cover the wetted area under the seal.

E. Pump bearing bracket shall have oil lubricated bronze journal and thrust bearings. Bracket shaft shall be alloy steel having ground and hardened thrust bearing faces. A flexible coupling to damper staring torque and torsional vibrations shall be employed.

F. The motor shall meet NEMA specifications and shall be the size, voltage and enclosure called for on the plans.

G. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.

H. Each pump shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to pump for owner’s reference.

I. Pumps shall be Series 60" as manufactured by ITT Bell and Gossett or approved equal by Taco or Grundfos.

J. Provide brass flanges of correct pipe thread size.

PART 3 EXECUTION

3.01 INSTALLATION OF FLEXIBLE COUPLED END SUCTION PUMPS

A. The pump and motor shall be mounted on a common base plate of heavy structural steel design and securely welded cross members and open grouting area.

B. Install base mounted pumps on concrete housekeeping base.

C. Each unit shall be leveled and grouted according to the manufacturer's instructions before alignment and start-up.

D. Pull and trim the pump impeller after a proportional balance has been done by the balance contractor. Hydronic systems shall be balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed. A balance report from the installer shall be furnished to the Code Enforcement Official and a copy included in the operating and maintenance manual.

E. Provide access space around HVAC pumps for service as indicated, but in no case less than that recommended by the manufacturer.

F. Alignment: Lubricate pumps before start-up. Start-up in accordance with the manufacturer’s instructions.

3.02 INSTALLATION OF IN-LINE CIRCULATING PUMPS

A. Install and support pump per manufacturer’s recommendation.

B. Provide access space around HVAC pumps for service as indicated, but in no case less than that recommended by the manufacturer

END OF SECTION

SECTION 232160

PIPES AND PIPE FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. Extent of pipes and pipe fittings required is indicated on drawings and/or specified in other Division-15 sections.

1.03 QUALITY ASSURANCE

A. Welding: Qualify welding procedures, welders and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and project site welding of piping work. Owner reserves the right to perform nondestructive testing of welded pipe joints by radiographic inspection whether or not explicitly required by code.

B. All welding of piping up to the second stop shall be done by the holder of an ASME "PP" Stamp.

C. Owner reserves the right to utilize any testing procedure listed in Chapter VI ANSI/ASME B31.1 to verify structural integrity of any weld(s) not meeting Engineer's approval. If integrity of weld(s) is found to be in compliance with ANSI B31.1, Owner will pay for the additional testing cost. If weld(s) is found to be deficient, contractor shall be responsible for all costs associated with the testing and repair of the weld(s).

PART 2 PRODUCTS

2.01 GENERAL

A. Where called for in the scope or where shown in drawings, use applicable products from those specified below. All pipes shall be American-made.

B. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

C. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.02 STEEL PIPES AND PIPE FITTINGS

A. Applications (Chilled, Condenser, and Hot Water – 2 1/2 inches and larger)
   1. Carbon Steel Pipe: Schedule 40 (minimum) ASTM A 53 for piping 4" and larger, A 106 or A 120 for piping 3" and smaller; except comply with ASTM A 53 or A 106 where close coiling or bending is required.
   2. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
   3. Malleable-Iron Threaded Unions: ANSI B16.39; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
   4. Threaded Pipe Plugs: ANSI B16.14.
   5. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
      a. Material Group: Group 1.1
      b. End Connections: Buttwelding
      c. Facings: Raised-face
   6. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe
   7. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (e.g., no close-nipples)

2.03 COPPER TUBE AND FITTINGS (Chilled And Hot Water 2” and smaller,Condensate Drain, Make-up Water)

A. Copper Tube: ASTM B 88; Type (wall thickness) as indicated for each service; hard-drawn temper, except as otherwise indicated.
   1. DWV Copper Tube: ASTM B 306.
   2. ACR Copper Tube: ASTM B 280.
   3. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
   4. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
   5. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23.
   6. Wrought-Copper Solder-Joint Draingage Fittings: ANSI 16.29.
   7. Cast-Copper Flared Tube Fittings: ANSI B16.26.
   8. Bronze Pipe Flanges/Fittings: ANSI 16.24.
   9. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

2.04 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

A. Provide welding materials to comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.

B. Provide Blue, Black or equal pipe joint compound.

C. Soldering Materials: Provide soldering materials as follows:
   1. Tin-Antimony Solder: ASTM B 32, Grade 95TA. (for pipe size 1-1/2" & under)
   2. Brazing Alloy: Silver 15%, copper 80%, phosphorous 5%. (for pipe size 2" and larger)
   3. Gaskets for Flanged Joints: ANSI B16.21; raised-face for steel flanges, unless otherwise indicated

2.05 DISSIMILAR PIPE UNIONS

A. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact

fit to pipe ends and subject to approval by plumbing code.

B. Piping Connectors for Dissimilar Pressure Pipe (Dielectric Union to be full-port, teflon seat ball brass valves)
   1. General: Provide brass ball valves to effectively isolate ferrous from non-ferrous piping (electric conductance), prevent galvanic action, and stop corrosion. Do not use rubber gasket type Dielectric Unions

PART 3 EXECUTION

3.01 INSTALLATION

A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. All 90-degree elbows shall have long radius. Two 45-degree elbows in lieu of one 90-degree elbow are not permitted where short elbows are used. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs unless such routing is clearly indicated on the drawings. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent -enclosure elements of building. Provide manual air vents at all high points in the piping. Provide a system drain and drains at all low points in the piping to allow complete system drainage. All vent and drain piping within the mechanical room shall run down the wall to the floor drain with shut-off ball valves located four feet above the ground. All other vents shall be piped to a nearby location facing downwards.

3.02 PIPING SYSTEM JOINTS

A. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

B. Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

C. Weld pipe joints in accordance with ASME B31.1 or ASME B31.9, as applicable.
   1. Welding: Pipe welding in sizes 2 inches and smaller may be either by the Manual Metallic Arc Process or the Oxyacetylene Welding Process and in sizes larger than 2 inches shall be by the Manual Metallic Arc Process with coated electrodes.
   2. All welding of steam piping shall be done in conformance with Chapter V of the latest edition of the ANSI/ASME Code for Power Piping B31.1.

D. Operators who are to do the welding must be properly qualified to do satisfactory work.

Proof of an operator's qualifications shall be either the Contractor's record of suitable tests passed within the preceding 90 days while in the employ of the Contractor, or maintaining his qualifications by welding at least every 90 days since last test. Any workman considered by the Engineer as not having the skill necessary for the work shall be required to pass an appropriate qualification test or shall be at once barred from further welding on the job.

E. Joints shall be properly beveled, thoroughly cleaned of rust or other foreign matter, and degreased before welding. Metallic arc-welding electrodes shall conform to ASTM A233. Oxyacetylene welding rods shall be commercial steel gas welding rods and shall conform to ASTM A251, GA60.

F. All piping connections shall be with pre-manufactured fittings (T, elbow, etc.) or with "weldolets," "threadolets" or "sockolets." This includes instrumentation such as thermometer wells, etc.

G. "Weldolets" with outlet size 2-1/2" and larger and "Threadolets" or "Sockolets" with outlet size 2" and smaller may be used for branch takeoff up to one half (1/2) diameter of main. Use "Threadolets" where threaded fittings are specified and use "Sockolets" where socket weld fittings are specified. Materials of "Weldolets" and "Threadolets" shall match material of piping.

H. Mitered ells, welded branch connections, notched tees and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges and reducing bushings are not allowed.

I. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.

3.03 CLEANING, FLUSHING, INSPECTING

A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Flush system with water until it runs clean. If Owner desires, introduce chemicals provided by Owner unless specific section of this Division dictates otherwise. Fill, vent, and circulate system while increasing temperature. Drain and refill system. Clean all strainers and check valves, etc. before refilling. Inspect each run of each system for completion of joints, supports and accessory items. Remove start up strainers and leave for owner’s inspection.

B. Inspect pressure piping in accordance with procedures of ASME B31.1 or ASME B31.9, as applicable. Owner reserves the right to perform radiographic inspections of welded joints in pressure piping.

3.04 PIPING TESTS

A. Test pressure piping in accordance with ASME B31.1 or ASME B31.9, as applicable. Minimum test pressure shall be 1-1/2 times the normal operating pressure or 100 psi, whichever is greater, unless otherwise indicated.

B. Notify Owner at least 24 hours in advance of pressure test to allow for Owner observation. If Owner is not properly notified, contractor shall repeat pressure test in Owner’s presence.

END OF SECTION

SECTION 232301

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
1. ANSI Compliance: Fabricate and install refrigerant piping and specialties in accordance with ANSI B31.5 and extend applicable lower limits to pressures below 15 psig.
2. ASHRAE Compliance: Fabricate and install refrigerant piping and specialties in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".

1.03 SUBMITTALS

A. Submit manufacturer's technical product data and installation instructions for refrigerant piping and specialties materials and products.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. Provide pipes and pipe fittings complying with Section 232160, in accordance with the following listing:
1. Size 1" and Larger: Copper tube: Type K, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints.
2. Size 3/4" and Smaller: Copper tube; Type ACR soft annealed temper fittings; cast copper alloy fittings for flared copper tubes; flared joints.

B. Soldered Joints: Solder joints using silver-lead solder, ASTM B32, Grade 96 TS.

2.02 SPECIAL REFRIGERANT VALVES

A. Special valves required for refrigerant piping include the following types:
1. Globe and Check Valves
2. Globe Shutoff Valves: Forged brass, packed, back seating, winged seal cap, 300 deg. F temperature rating, 500 psi working pressure.
3. Check Valves: Forged brass, accessible internal parts, soft synthetic seat, fully guided brass piston and stainless steel spring, 250 deg. F temperature rating, 500 psi working pressure.

B. Solenoid Valves:
1. 2-Way Solenoid Valves: Forged brass, designed to conform to ARI 760, normally closed, teflon valve seat, NEMA 1 solenoid enclosure, 24 volt, 60 Hz. UL-listed,

1/2" conduit adapter, 250 deg.F temperature rating, 400 psi working pressure.

C. Manual Operator: Provide manual operator to open valve.

D. Refrigerant Strainers: Brass shell and end connections, brazed joints, model screen, 100 mesh, UL-listed, 350 psi working pressure.

E. Moisture-Liquid Indicator: Forged brass, single port, removable cap, polished optical glass, solder connections, UL-listed, 200 deg.F temperature rating, 500 psi working pressure.

F. Refrigerant Filter-Driers: Corrosion-resistant steel shell, steel flange ring and spring, wrought copper fittings, ductile iron cover plate with steel cap screws, replaceable filter-drier core, 500 psi working pressure.

G. Evaporator Pressure Regulators: Provide corrosion-resistant, spring loaded, stainless steel springs, pressure operated, evaporated pressure regulator, in size and working pressure indicated, with copper connections.

H. Refrigerant Discharge Line Mufflers: Provide discharge line mufflers as recommended by equipment for use in service indicated, UL-listed.

2.03 REFRIGERANT MONITORING SYSTEM

A. Refrigerant Gas Leak Detector

1. The refrigerant gas leak detector shall monitor for trace amount of HFCs specifically R-410A.
2. The refrigerant gas leak detector shall operate 24 hours a day to ensure maximum protection.
3. The refrigerant gas leak detector shall operate a minimum of three sensors, have two alarm levels, a 32 alarm log, a programmable setback, and a remote communication option. It shall utilize a built in keypad and display.
4. The Refrigerant Gas Leak Detector sensors shall be electronically calibrated by the control. Automatic calibration shall adjust for clean air quality without using voltage meters or portable refrigerant detectors.
5. The Refrigerant Gas Leak Detector shall have a pilot light to indicate that the system is operating. All electronics shall be recessed inside the housing to protect them from excessive airflow and physical damage.
6. The Refrigerant Gas Leak Detector shall have an ALARM LOG that retains the last 32 alarms. The ALARM LOG identifies the sensor, the alarm level, the type of alarm, and the time and date of each alarm.
7. The Refrigerant Gas Leak Detector shall allow the user to program the alarm level and time delay for each sensor. This lets the user compensate for variations in air quality in the area where each sensor is located.
8. The Refrigerant Gas Leak Detector shall incorporate a PROGRAMMABLE SETBACK feature that allows the user to account for special conditions in a sensing area. The user can program a time period to assign a different alarm level and time delay. This is particularly useful in areas where propane floor buffing or exhaust fan activation results in a higher concentration of gas at a scheduled time. The PROGRAMMABLE SETBACK feature provides the maximum level of detection and dramatically reduces false alarms.
9. The Refrigerant Gas Leak Detector shall have a second alarm level that can be used to activate exhaust systems or a secondary alarm when refrigerant levels reach a dangerous level.
10. The Refrigerant Gas Leak Sensor shall be capable of being located up to 800 feet

from the control unit with no loss of sensitivity.

11. The Refrigerant Gas Leak Detector shall be capable of being monitored by a remote Communication System. Communication shall be accomplished across a standard telephone line using an IBM or compatible computer and amodem (2400 or 9600 baud).
12. The Refrigerant Gas Leak Detector shall be hard wired to an emergency power circuit.
13. The following lists the features of a "SHERLOCK 202" Refrigerant Leak Detector system as manufactured by Genesis International, Inc., 1040 Fox Chase Industrial Drive, Arnold MO 63010, Telephone (314) 282-0011. Other manufacturers meeting the requirements of this specification will be considered for equivalency.

Power Input:	120 VAC (220 Optional), 1 Amp, 50/60 Hz
Outputs:	Dual Alarm Level Relays
	Each alarm uses a DPDT relay.
	Max. 5 Amps. at 240 VAC
Inputs:	At least 6 Sensors monitor various gases
Environment:	CONTROL:
	-10 to 125F, 0-95% RH non-condensing
	SENSOR:
	40 to 120 F, 35-90% RH non-condensing
Display:	10 Character, Alpha-Numeric
	Vacuum Fluorescent Display
	Reading Scale 0-1000
	Each scale unit equals 3 PPM +/- 10%
	Effective Range 25 to 3000 PPM
Calibration:	Sensor is Factory Calibrated for fresh air.
	FIELD CALIBRATION:
	Menu-driven function of the control
Air Flow:	2 feet/sec. at the Sensor
Sensor Cable:	3-wire, Stranded, Shielded #20 AWG
	Belden #9492 up to 800 feet

14. The Refrigerant Gas Leak Detector shall be selected for the specific refrigerant used in each mechanical equipment room. When more than one refrigerant is used, sensors shall be provided for each refrigerant and the detector shall be capable of sensing a leak from any source present in the mechanical equipment room.

PART 3 EXECUTION

3.01 INSTALLATION OF REFRIGERANT PIPING

A. Install refrigerant piping with 1/4" per foot (1%) downward slope in direction of oil return to compressor. Provide oil traps and double risers where indicated, and where required to provide oil return.

B. Clean refrigerant piping by swabbing with dry lineless (linen) cloth, followed by refrigerant oil soaked swab. Remove excess oil by swabbing with cloth solvent in high flash point petroleum solvent, squeezed dry.

C. Bleed dry nitrogen through refrigerant piping during brazing operations.

3.02 FIELD QUALITY CONTROL

A. Refrigerant piping Leak Test: Prior to initial operation, clean and test refrigerant piping in accordance with ANSI B31.5., "Refrigeration Piping". Perform initial test with dry nitrogen, using soap solution to test all joints. Perform final test with 27" vacuum, and then 200 psi using electronic leak detector. System must be entirely leak-free.

B. Repair or replace refrigerant piping as required to eliminate leaks, and retest as specified to demonstrate compliance.

3.03 DEHYDRATION AND CHARGING SYSTEM

A. Install core in filter dryer after leak test but before evacuation.

B. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg. F (2 deg. C) is indicated on vacuum dehydration indicator.

C. During evacuation, apply heat to pockets, elbows, and low spots in piping.

D. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

E. Break vacuum with refrigerant gas. Allow pressure to build up 2 psi.

F. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

END OF SECTION

SECTION 232500

WATER CONDITIONING

PART I GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. Water conditioning equipment and programs to control scale, corrosion, oxygen pitting and organic growth shall be provided from the date the equipment is started until one year after the final acceptance of each system. The chemicals used and feeding methods employed shall comply with all codes and with regulations of authorities having jurisdiction. Required permits for the disposal of waste from treated systems shall be obtained prior to the installation of equipment and the initiation of conditioning programs. The chemical manufacturer shall provide supervision and service for all phases of water treatment consisting of field supervision for the installation and adjustments of automatic feeding equipment and operator training in the use of chemical feeding equipment.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data, including MSDS sheets, and installation instructions for water conditioning materials and products. Include data on chemical feed pumps, water softener and other equipment, spare parts lists, chemicals, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations and values.

PART 2 PRODUCTS

2.01 CHILLER AND BOILER WATER TREATMENT FEEDER

A. Chemical Feeder: Bypass type chemical feeders of 2 gallon capacity, welded steel construction; 125 psig working pressure; complete with fill funnel and inlet, outlet, vent and drain valves.

B. Chemicals shall be specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, developed based on a water analysis of make-up water.

PART 3 EXECUTION

3.01 GENERAL

A. Water conditioning installation shall be as specified and indicated schematically on the plans. The installation shall be complete with all required equipment, chemicals, material and appurtenances, whether or not specifically implied or expressed herein or indicated on the

Drawings. Electrical work shall be done in accordance with Section 15030. Materials of construction of equipment furnished shall be suitable for the chemicals being handled and as indicated. Chemical and softened water piping and piping accessories shall be Schedule 80 or stainless steel as approved by the chemical manufacturer. Chemicals, Feed and bleed equipment, and supervision for water conditioning programs shall be provided by a recognized water conditioning company with qualified laboratory and field service facilities readily available to the site. This company shall provide all chemicals, test kits and reagents required for the period of time hereinbefore specified including initial dosage and supervision and service for all phases of the water treatment program including the following:

1. Field supervision and certification of initial cleanout.
2. Field supervision for the installation and adjustment of automatic feed equipment and for the injection of initial dosages of treatment in all systems.
3. The services of a qualified field representative on a regular basis to make complete on-the-spot water analysis of all systems. A written report of the findings will be left with the Owner, and confirmation reports will be forwarded to the Engineer. As a minimum, reports shall be submitted monthly. However, additional visits may be required during startup and during seasonal operational changes. As a minimum the following tests shall be performed and the results recorded on the raw make up water, condensate/feedwater tank water, and the water in each boiler.

pH	TDS (Total Dissolved Solids)	Total Alkilinity
Hardness (total)	Hardness (CaCo3)	Chlorides
Silica	Iron	LSI

B. The contractor should also perform any additional tests, specific to his chemicals, to determine the quantity of treatment chemicals is satisfactory, or any tests that are necessary to fully determine whether the treatment program is adequate.

C. Approximately 30 days prior to the end of the guarantee period, the field representative shall completely analyze all water systems and take action to correct all discrepancies noted. A written report of his findings, including a description of all abnormalities and corrective action taken, shall be submitted to the Owner.

3.02 INITIAL CLEANOUT

A. Contractor is to furnish pre-cleaning chemicals for the cleaning of new chillers, new boilers, and heating hot water, chilled water, and condenser water piping. Prior to extended operation and after the flushing operation specified in Section 15510, all new piping and heat transfer equipment shall be chemically cleaned with a material especially formulated to remove oil, grease, mill scale and other foreign materials. Cleanout operation shall be performed according to manufacturer’s recommendations and under the supervision of the water conditioning company who shall perform all tests and submit written certification that the system is clean prior to acceptance of the installation.

3.03 CHEMICAL TREATMENT

A. Chemicals shall be specially formulated to prevent accumulation of scale and corrosion in piping systems and connected equipment, and to prevent organic growth developed based on a water analysis of make-up water, and in accordance with equipment manufacturer’s recommendations.

3.04 O&M MANUALS

A. Include manufacturer's technical product data, including MSDS sheets, and installation

instructions for water conditioning materials and products. Include data on chemical feed pumps, water softener and other equipment, spare parts lists, chemicals, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations and values.

END OF SECTION

SECTION 233100

DUCTWORK AND DAMPERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions, Division-1 Specification sections and other Division 23 specification sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
1. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B “Standard for the Installation of Warm Air Heating and Air Conditioning Systems”.

PART 2 PRODUCTS

2.01 DUCTWORK MATERIALS

A. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lock forming quality; with G 90 zinc coating in accordance with ASTM A 525.

B. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A 167; Type 302, 304, or 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

C. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14.

2.02 FABRICATION

A. General: All low velocity sheetmetal ductwork shall be constructed in accordance with recommendations of Low Pressure Duct Construction Standard, of Sheet Metal and Air Conditioning Contractors National Association, Inc., Fifth Edition, 1976, AIA File No. 30-D-4, hereafter abbreviated SMACNA-I and latest recommendations of the ASHRAE Handbook “HVAC Systems and Equipment.” Duct systems shall be complete including all duct fittings, turning vanes, hangers, and supports shown on drawings and in SMACNA-I. Reference to plate numbers and figure numbers apply to this Duct Manual.

B. Shop fabricated ductwork in maximum 8-ft lengths, unless otherwise indicated. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation. Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards" (First Edition, 1985) in accordance with the following:

Application	Construction Pressure STD
Return Ductwork	-1" W.G.
Supply Ductwork with Fan Static Pressure Less Than 2.5" W.G.	+1" W.G.
Supply Ductwork Downstream of Air Terminals	+1" W.G.
Supply Ductwork with Fan Static Pressure Greater Than 2.5" W.G.	+2" W.G.
Supply Ductwork with Fan Static Pressure Greater than 5.0"W.G.	+3" W.G.
General Exhaust Ductwork	-1" W.G.
Special Exhaust Ductwork	As indicated on drawings

C. Cross-break all flat panels between bracing except where rigid insulation is applied.

D. Elbows shall be standard radius or square with air foil double vanes, round duct elbows shall be of five piece construction.

E. Transitions shall be made with maximum angle of 15 degrees with straight duct for diverging flow, 20 degrees for converging flow.

F. Fabricate Ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining adhesive, and fasten with mechanical fasteners. Note that duct sizes on the drawing are "net" and must be increased to allow for duct liner unless ductwrap type insulation is allowed in accordance with Section 230700.

2.03 FACTORY-FABRICATED MEDIUM PRESSURE DUCTWORK

A. Gage: 18-gage minimum for ducts and fittings.

B. Elbows: One piece construction for 90E and 45E elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint. Provide turning vanes in all 90E elbows.

C. Divided Flow Fittings: 90E Tees, constructed with saddle tap spot welded and bonded to duct fitting body.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork to achieve airtight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Rigid round, rectangular and flat oval metal ducts shall be installed with support systems in accordance with SMACNA HVAC duct construction standards. Horizontal ducts shall have a support within two feet of each elbow and within four feet of each branch intersection. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.

B. Seal all exhaust, return and supply duct joints with mastic. Do not insulate until engineer has reviewed installation.

C. Refer to exterior duct insulation detail on drawing M-500.

D. Duct Joints:

1. Transverse duct joints in low pressure rectangular ducts shall be made with the Ductmate System or an approved equal. The Ductmate System components shall be of standard catalog manufacture as supplied by Ductmate Industries, Inc., of Pittsburgh, PA or Stockton, CA. automated ductwork Mfg. Co., McGil Airflow Corp.
2. The installation of the Ductmate System shall be in accordance with the manufacturer's printed instruction and installation manual. Ductmate joints are equivalent of SMACNA Angle Reinforced Standing Seam (T-16).
3. The Ductmate angle shall be securely fastened to the duct walls using spotwelding, self-drilling screws or rivets. Fasteners spacing shall be as recommended in the manufacturers' installation manual for the applicable pressure class.
4. A continuous strip of closed cell gasket tape, size 1/4 inch x 3/4 inch shall be installed between the mating flanges of the companion angles at each transverse joint and joint shall be made up using 3/8 inch diameter x 1 inch long plated bolts and nuts. Drive-on or snap-on cleats shall be used at spacings as recommended in the manufacturer's installation manual.

E. Flexible Duct:
1. Type B, Round, Low Pressure Factory insulated with vapor barrier and factory attached clamps. Do not exceed 5 foot length. Not to exceed manufacturer recommendations for minimum bend ratio.
2. Flexible duct good for 1-1/2 inch W.G. internal S.P. and shall meet the Class 1 requirements of NFPA 90A-Underwriters.
3. Flame spread rating of 25 and smoke developed rating of 50 or under.
4. Each end shall be banded (draw type) for connection to duct fitting and diffuser boot.
5. Install flexible ducts in accordance with Section III of SMACNA's HVAC Duct Construction Standards."
6. Make: Genflex SLF-25, Owens-Corning, Jenflex, Wiremold, or approved equal.

F. Volume Control Dampers: Provide where specified above, where indicated on drawing and in all branches or at all supply, return air, exhaust or transfer openings required to balance system whether or not specifically shown on drawings Dampers shall be locking quadrant type, manual balancing clamps.
1. Blades: 22 gauge minimum galvanized sheet steel for rectangular 20 gauge for round.
2. Frames: 22 gauge minimum galvanized sheet steel for rectangular, 20 gauge for round
3. Bearings: Synthetic.
4. Control shaft/hand quadrant: 3/8" square axle shaft, extending beyond frame with factory supplied locking hand quadrant for field mounting. Provide 2" hand quadrant standoff bracket for dampers installed on duct wrapped with external insulation.
5. Accessibility: All dampers shall be adjustable after building is completed. Where dampers are hidden behind furred spaces, damper rods shall be adjustable from flush mounted boxes similar to the Young concealed damper regulator.
6. Make: Ruskin MD25 for rectangular and MDRS25 for round, or equivalent by Arrow United Industries, NCA or Vent Products Co., Inc.

G. Automatic control dampers: Furnish and install where specified or indicated on drawings. Damper motors will be furnished and installed by the DDC Contractor. Control and low voltage power wiring will be provided by DDC contractor. Provide transition or blank off baffles where required to suit damper size.
1. Type: Opposed blade for modulating service or non-modulating service. Parallel blade is acceptable for non-modulating service.

2. Blades: 16 gage minimum galvanized sheet steel, interlocking design.
3. Frames: 16 gage minimum galvanized sheet steel.
4. Bearings: Nylon
5. Seals: Synthetic elastomer installed on blade edges and top and bottom strips of each damper, with flexible metal compression seal on sides.
6. Leakage: Conform to leakage requirements as prescribed by SMACNA for medium pressure duct systems.
7. Automatic Control Damper actuators shall provide pilot positioning where sequenced operation is required with adjustable starting point and range, 25% surplus power, spring return.
8. Make: Ruskin CD-60 low leakage, low noise damper or approved equal by Arrow United Industries, NCA or Vent Products Co.

H. Access Doors: Required as shown on plans and to provide access for all fire dampers, coils, damper motors, dampers, bearings, etc. Sizes shall be approximately 18 inches square wherever possible except in apparatus casing. Construction shall be panel type, insulated where adjoining duct or casing is insulated, in accordance with SMACNA-I construction details. Alternately, use Ventlok stamped insulated access doors, door gasket, insulated with 2 inch fiberglass, loose pin hinges, as manufactured by Ventfabrics Ventlok or approved equal. 16 x 24 inch where possible, or largest possible size where 16 x 24 inch will not fit.

I. Flexible Duct Connections: Install at all duct connections to roof top units and ducts crossing building expansion joints and where condensation may occur. Use double fabric of approved flame-proof material similar to Ventfab. However, asbestos containing materials shall not be used. Material used shall be applicable for intended use. Assemble to duct and blower with washer strip of 1 inch x 1/8 galvanized steel, bolted in o.c. leaving 2 inch slack at joints.

J. Rain Hoods: Provide galvanized sheet metal rain hood over damper motors installed outside the building (exposed to weather).

K. Fire Dampers:
1. The fire dampers shall be fabricated of galvanized steel meeting ASTM-A-525-65. The damper frame shall be of such design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve. The damper frame thickness sleeve shall not be less than as recommended in Schedule 1 of SMACNA Fire Damper and Heat Stop Guide, 2nd Ed., 1981.
2. Unless otherwise noted, all fire dampers shall be UL 555 dynamic rating labeled for 1-1/2 hr. and 3 hr. (refer to drawing) rating. Fire dampers are required for each fire separation whether or not specifically shown on drawings. See architectural drawings and specifications for fire barriers. Fire dampers shall have 165° F fusible link.
3. All square or rectangular fire dampers shall be similar to Phillips Fire Damper Series S2C2, Ruskin or National Controlled Air, Inc.
4. Installation of fire dampers shall comply with NFPA-90A, SMACNA-I and SMACNA Fire Damper and Heat Stop Guide for Air Handling System, 2nd Edition, 1981. Fire damper sleeve shall not be attached to wall or slab, but retained on both sides by a 16 gauge angle frame attached to sleeve by welds or #10 x 2 sheet metal screw or 1/4 x 2 bolts - not over 12 inches on center. This angle frame also closes all clearance between sleeve and wall or slab.

L. Trim Collars: Wherever duct passes exposed to view through walls, the opening shall be framed with 1 inch x 1 inch x 1/8 inch angles on both sides of partitions with corners mitered, welded and ground smooth.

M. Turning Vanes: Shall be installed in all square elbows. Vanes shall be manufactured from

minimum 26 gauge electro-galvanized steel and sides shall be manufactured from minimum 24 gauge electro-galvanized steel with assembled slots located on design center of 2-1/8 inches. Turning vanes shall be high-efficiency profile type (H.E.P.) as manufactured by AER/DYNE Co., Los Altos, CA 94022, or equivalent by American Elgin or Ductmate Industries, Inc. Submit shop drawing for approval.

3.02 ADJUSTING AND CLEANING:

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed. Similarly, provide temporary closure of ends of all prefabricated ductwork in storage.

END OF SECTION

SECTION 237300

AIR HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air handling units.

1.02 RELATED SECTIONS

A. Drawings and Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division 1 Specifications Sections, apply to work of this section.

1.03 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data:
1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include installation instructions.

1.04 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under provisions of Division 1.

B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.05 QUALITY ASSURANCE

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

1.06 REGULATORY REQUIREMENTS

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

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Deliver, store protect and handle products to site under provisions of Section 15010.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Trane., McQuay, Carrier.

2.02 GENERAL DESCRIPTION

A. Configuration: Fabricate with fan and coil section plus accessories, including:
1. Filter section.
2. Electric auxiliary heat

B. Performance Base: Sea level conditions.

C. Fabrication: Conform to AMCA 99 and ARI 430.

2.03 CASING

A. Construction: Fabricate on channel base [and drain pan] of welded steel. Assemble sections with gaskets and bolts.
1. Outside Casing:
   a. Galvanized Steel: 18 gage.
   b. Finish: Manufacturers standard paint on exterior.
2. Floor Plate:
   a. Galvanized Steel: 10 gage

B. Insulation: Single wall sections provided with 1" foil faced insulation complying with NFPA 90A and ASTM C665.
1. "K" value at 75 degrees F: Maximum 0.26 Btuh/inch/sq ft/degrees F.
2. Density: 1 inch thick, 1.5 lbs/cu ft.

C. Finish: Zinc chromate, iron oxide, phenolic resin paint.

D. Access Doors: Double-wall galvanized steel panels with neoprene gasketing around the full perimeter. Provide two (2) position "ventlock" style latches operable from both sides.

E. Strength: Provide structure to brace casings for suction pressure of 4.0 inch wg, with maximum deflection of 1 in 200.

2.04 FANS

A. Type: Forward curved, centrifugal.

B. Performance Ratings: Conform to AMCA 210.

C. Sound Ratings: AMCA 301; tested to AMCA 300

D. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings extended to exterior of casing with copper tube and grease fitting rigidly attached to casing.

E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory-mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on vibration isolators.

F. VFD: Fan motor shall have 2-speed control using a VFD.

2.05 BEARINGS AND DRIVES

A. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA 9 L-50 life at 200,000 hours.

B. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

C. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

2.06 COILS

A. Direct expansion coils are constructed with galvanized steel casings and aluminum fins, which are mechanically bonded to 1/2" seamless copper tubing. DX coils are available with 4 or 6 rows and either 9, 12 or 14 fins per inch and 3/16" or 1/4" distributors. These coils have a dual circuit design with multiple distributors and an intertwined arrangement. All DX coils are factory tested with a 450 psi air under water. All DX coils have distributor tubes brazed into place with tubing extended to the exterior of the unit casing for field connection. Coils ship sealed with a dry air charge to minimize moisture contamination.

B. The drainpans are double wall foamed in place assemblies made of a non-corrosive polymer material sloped in two directions. The drainpan is fully drainable. The coils mount above the drainpan, not in the drainpan, thus allowing the drainpan to be fully inspected and cleaned. The drain connection is unthreaded 1" schedule 40 polymer for solvent bonding.

C. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410. [Refer to Section 15790.]

D. Fabrication:
1. Tubes: 5/8 inch (16 mm) OD seamless copper expanded into fins, brazed joints.

2. Fins: Aluminum.
3. Casing: Die formed channel frame of galvanized steel.

E. Refrigerant Coil:
1. Headers: Seamless copper tubes with silver brazed joints.
2. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
3. Configuration: See coil detail.

2.07 FILTERS

A. Filter Media: UL 900 listed, Class I or Class II.

B. 2 inches deep (10 ton AHU only), disposable, extended area panel filters.

C. Provide MERV 13 filters at completion of construction.

2.08 ELECTRIC HEATER

A. Electric Heater: UL and CSA approved auxiliary electric heat module shall be included for installation directly on fan discharge. Electric Heater shall require single-point electric power connection and shall include terminal strip connections. Electric heater elements shall be constructed of heavy-duty nickel chromium elements delta connected. The heater shall have pilot duty with secondary backup fuse links for automatic reset of high limit controls

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturers' instructions.

B. Bolt sections together with gaskets. Isolate fan section with flexible duct connections.

C. Install flexible connections specified in Section 15910 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install snubbers to prevent tension in flexible connectors when fan is operating.

E. Provide sheaves required for final air balance.

F. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil.

G. Insulate coil headers located outside air flow as specified for piping. Refer to Section 15260.

END OF SECTION

SECTION 237433

HEATING AND MAKEUP AIR UNITS

PART 1 GENERAL

1.01 SUMMARY

A. This section includes Units with integral Heating. Integral heating source shall be Electric heating. Airflow arrangement shall be Outdoor Air with Recirculation. Each unit shall be constructed in a horizontal configuration and shall incorporate additional product requirements as listed in Section 2 of this specification.

1.02 SUBMITTALS

A. Product Data: For each type or model, include the following:
   1. Complete fan performance curves for Supply Air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
   2. Sound performance data for Supply Air, as tested in an AMCA Certified chamber.
   3. Motor ratings, electrical characteristics and motor and fan accessories.
   4. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
   5. Estimated gross weight of each installed unit.
   6. Installation, Operating and Maintenance manual (IOM) for each model.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain Packaged Make-Up Air Unit with Integral Heating with all appurtenant components or accessories from a single manufacturer.

B. Product Options: Drawings must indicate size, profiles and dimensional requirements of Make-Up Air Units and are to be based on the specific system indicated. Refer to Division 1 Section "Product Requirements".

C. Certifications:
   1. Entire unit shall be ETL Certified per UL 1995 and bear an ETL mark
   2. Coils shall be Recognized Components per UL 1995, CAN/CSA C22.2 No. 236.05. Coil performance shall be calculated in accordance with AHRI 410.

1.04 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each Make-Up Air Unit and associated ducting, plumbing and electrical systems.

B. Coordinate sequencing of construction of associated plumbing, HVAC, and electrical supply.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include,

but are not limited to:

1. Greenheck Fan Corporation

2.02 MANUFACTURED UNITS

A. Unit with Integral Heating shall be fully assembled at the the factory and consist of an insulated metal cabinet, an outdoor air intake weatherhood with aluminum mesh, sensors, freeze protection, curb assembly, low-leakage motorized recirculating dampers, supply air blower assembly, electrical control center. All specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

2.03 CABINET

A. Materials: Formed, double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

1. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge G60 galvanized steel. Base rail is 12 gauge, galvazined (G90) steel.
2. Internal assemblies: 24 guage, galvanized (G90) steel except for motor supports which shall be a minimum 14 guage galvanized (G90) steel.

B. Cabinet Insulation: Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
    a. Thickness: 1 inch (25 mm)
    b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
    c. Location and application: Floor of each unit shall be insulated with fiberglass insulation. Full interior coverage of entire cabinet to include walls and roof of unit shall be semi-rigid type and installed between inner and outer shells of all cabinet exterior components when double walls are specified.

C. Access panels: Unit shall be equipped with insulated hinged access panels to provide easy access to all major components. Access panels shall be fabricated of 18 gauge galvanized G90 steel.

D. Supply Air blower assembly options: Forward curve blower: Blower assembly consists of an electric motor and a belt driven, double width, and double inlet forward curve blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on minimum 1.125 inch thick neoprene vibration isolators.

E. Control center / connections:

1. Unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.

F. Electric heat: Electric heater is to be UL listed with open coil elements. Heater control cabinet is to be installed within the units heating section. Electric heater is to be provided with SCR controls. Electric heater is to be controlled off of VernierSCR. Units with electric heat are to be provided with a center that shall be constructed to permit single-point high voltage power supply connections.

G. Motorized Recirculating Air Damper designed to permit 100% recirculation of building air shall be factory installed. Damper shall be controlled by BMSControl.

H. Sensors are considered to be part of various optional operational modes or device controllers and are to be factory supplied and installed as specified by the A/E.

I. Curb Assembly: A curb assembly shall be made of galvanized steel provided by the factory for field assembly and installation as part of this division. The curb shall include a duct adapter(s) for supply and return air. The installing contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install apporpriate insulation for the curb assembly.

J. Frost Control for optional water coil.

2.04 BLOWER-FC

A. Blower section construction, Supply Air: Belt drive motor and blower shall be assembled onto a minimum 14 gauge galvanized steel platform and must have neoprene vibration isolation devices, minimum of 1-1/8 inches thick.

B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

C. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.

D. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.

E. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency. Ratings are to be established in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating".

2.05 MOTORS

A. General: Blower motors greater than 3/4 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley. Comply with requirements in Division 23 05 13, matched with fan load.

B. Motors shall be 60 cycle, 3 phase, 460 volt.

2.06 UNIT CONTROLS

A. The unit shall be constructed so that it can function as a stand-alone heating system controlled by factory-supplied remote panel, thermostats and sensors or it can be operated as a heating system controlled by a Building Management System (BMS).

B. Variable Frequency Drive (VFD): Unit shall have factory installed variable frequency drive for modulation of the supply air blower assembly. The VFD shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.

C. Sensors to be provided with the unit:
1. Heating Inlet Air Sensor
2. Dirty Filter Sensor

2.07 FILTERS

A. Unit shall have 2" thick MERV 8 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.

B. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.

3.03 CONNECTIONS

A. In all cases, industry Best Practices shall be incorporated. Connections are to be made subject to the installation requirements shown above.
1. Piping installation requirements are specified in Division 22 (Plumbing). Drawings indicate general arrangement of piping, fittings and specialties.
2. Duct installation and connection requirements are specified in Division 23 of this document.
3. Electrical installation requirements are specified in Division 26 of this document.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to A/E in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM.

3.05 START-UP SERVICE

A. Engage a factory authorized service representative to perform startup service. Clean entire unit, comb coil fins as necessary, and install clean filters. Verify water source for compliance with manufacturer's requirements for flow and temperature. Measure and record electrical values for voltage and amperage. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein.

3.06 DEMONSTRATION AND TRAINING

A. Engage a factory authorized service representative to train owner's maintenance personnel to adjust, operate and maintain the entire Make-Up Air unit. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

END OF SECTION

SECTION 238147

SPLIT SYTEM AIR COOLED CONDENSER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data for condensing units, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and startup instructions. Submit manufacturer's technical product data for air handling units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, gages and finishes of materials, and installation and start-up instructions.

B. Wiring Diagrams: Submit ladder type wiring diagrams for power and control wiring required for final installation of air handling units, auxiliary heaters, condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. ARI Compliance: Capacity ratings for heat pump/condensing units shall be in accordance with ARI Standard 360, "Standard for Commercial and Industrial Unitary Air Conditioning Equipment" for units of 135 MBH capacity or greater; ARI Standard 210 "Standard for Unitary Air Conditioning Equipment" for units of capacity less than 135 MBH. Air handling unit shall be rated and tested in accordance with ARI standard 340/360.
   2. AMCA Compliance: Test and rate air handling units in accordance with AMCA standards.
   3. ASHRAE 15 Compliance: Refrigeration system of heat pump/condensing units shall be constructed in accordance with ASHRAE standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".
   4. UL Compliance: Condensing units shall be UL listed and labeled. Display certification symbol on units of certified models.

PART 2 PRODUCTS

2.01 AIR-COOLED CONDENSING UNITS

A. General: Factory assembled and tested split system condensing units, consisting of casing, compressors, condenser coils, condenser fans motors, and unit controls. Capacities and electrical characteristics as scheduled. Acceptable refrigerants shall be R-410A.

B. Compressor: Scroll type compressor, designed for air cooled condensing, complete with

crankcase sight glass, crankcase heater, and back-seating service access valves on suction and discharge ports. Minimum 2 compressors for units over 5 tons.

C. Controls: Operating and safety controls shall include high and low pressure cutouts, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Provide magnetic contactors for compressor and condenser fan motors. Provide timing device to prevent excessive compressor cycling, and time delay relays for dual compressor units. Provide phase protection to shut down unit.

D. Condensing Section: Condenser coil shall consist of spine fin construction of aluminum material or shall be seamless copper tubing mechanically bonded to heavy duty, configured aluminum fins, with separate and independent refrigeration circuit for each compressor. Units shall include liquid accumulator and sub-cooling circuit, and back-seating liquid line service access valve. Condenser coils shall be factory tested. Coils may also be all aluminum. Provide hail guard coil protection.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install air-cooled condensing units in accordance with manufacturer's installation instructions.

B. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

3.02 FIELD QUALITY CONTROL

A. Charge systems with refrigerant and oil, and test for leaks.

B. Repair leaks and replace lost refrigerant and oil.

3.03 DEMONSTRATION

A. Start-up systems in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Train Owner's personnel on start-up and shutdown procedures, troubleshooting procedures, servicing, and preventive maintenance schedule and procedures.

C. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION

SECTION 238219

BLOWER COILS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Standard General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specification sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards:
1. ARI Compliance: Test and rate fan coil units in accordance with ARI Standard 440 "Room Fan-coil Air Conditioners".
2. UL Compliance: Construct and install fan coil units in compliance with UL883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

PART 2 PRODUCTS

2.01 BLOWER COIL UNIT

A. Unit shall consist of basic unit casing enclosed in a heavy-gauge cabinet finished with an electrostatically applied, baked on paint. Blower coil cabinet shall have a double deflection discharge grille with return air through the back of the unit. Cabinet shall include a hinged panel for access.

B. Coils shall have aluminum fins with copper tubes mechanically expanded for a permanent bond. Water coils shall have a manual air vent. Coil performance shall be as tabulated in the schedule. Coil shall be provided for chilled water.

C. Fans shall be DWDI forward curved, centrifugal type. Fan housing shall be fabricated of heavy-gauge galvanized steel. Fan and motor shafts shall have permanently lubricated ball bearings.

D. Units shall have 120/60/1, sleeve bearing, permanent split capacitor motors with inherent thermal overload protection with automatic reset and resilient mounts. Units shall have a factory-mounted service disconnect.

E. Drain pan shall be constructed of 20-gauge galvanized steel or high-grade plastic, insulated with closed cell insulation.

F. Cabinet insulation shall be 1/2" multi-density glass fiber. Units shall be insulated with 1/2" multi-density glass fiber on the sides, top and front panels.

G. Filters shall be 1” pleated media type, minimum efficiency 20%, throwaway type. 1” glass fiber type shall be utilized during the construction period, with the pleated filters installed at substantial completion.

H. Make: AAF, Carrier, Enviro Tech, or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION OF BLOWER COILS

A. General: Install blower coils as indicated, and in accordance with manufacturer's installation instructions.

B. Mount units dead level.

C. Locate blower coils as indicated. Coordinate with other trades.

D. Support horizontal units from structure with hanging rods, factory mounting brackets, and vibration isolators. Secure vertical units to the wall with anchors.

E. Protect units with protective covers during balance of construction.

END OF SECTION

SECTION 238146

WATER TO WATER HEAT PUMPS

PART 1 GENERAL

1.01 GENERAL

A. Drawings, Instructions to Bidders and General Conditions of the Construction Contract, including Supplementary General Conditions and Division-1 Specifications sections, apply to work of this section.

1.02 QUALITY ASSURANCE

A. Codes and Standards: ASME Compliance

1.03 SUBMITTALS

A. Product Data: Include capacities, dimensions, startup checklist, installed devices and features, O&M manuals.

B. Coordination Drawings: Floor plans drawn to scale and coordinating wall penetrations.

C. Operation and Maintenance Data: For Heat Pump and accessories to include in Operation and Maintenance Manuals

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Equipment shall be completely assembled, piped, internally wired, fully charged with R410A, and test operated at the factory. A controls field interface terminal strip, and all safety controls shall be furnished, installed and tested by the unit manufacturer. The unit shall be rated in accordance with ISO-ARI 1356-2. The unit shall be warranted by the manufacturer against defects in materials and workmanship for a period of one year on all parts, and 5 years on the compressor.

B. The units shall be designed to operate with entering fluid temperatures between 20°F (-7°C) and 120°F (49°C).

C. Water to water heat pump shall be as manufactured by ClimateMaster, Water Furnace, or Florida Heat Pump.

2.02 CASING AND CABINET

A. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. The interior shall be insulated with ½" (12.7mm) thick, multi density, coated, glass fiber. Access to the refrigerant and controls shall be provided through the front and side, access panels. All units shall allow front service access to replace the compressor and electrical components without unit removal. Procedures for proper access inspection and cleaning of the unit shall be included in the maintenance manual.

B. All panels shall be insulated with ½ inch thick dual density bonded glass fiber. The insulation shall meet the erosion requirements of UL 181. It shall have a flame spread of less than 25 and a smoke developed classification of less than 50 per ASTME-84 and UL 723.

2.03 REFRIGERATION CIRCUITS

A. All units shall contain a sealed refrigerant circuit including a scroll compressor, bi-directional thermal expansion valve metering device, coaxial style fluid-to-refrigerant heat exchangers, refrigerant reversing valve and service ports.

B. Compressor shall be high efficiency, designed for heat pump duty, and mounted on rubber vibration isolators. Vibration isolation shall be provided through rubber mounting devices located underneath the compressor.

C. Compressor motors shall be equipped with overload protection. Internal thermal overload protection shall be provided. Protection against excessive discharge pressure shall be provided by means of a high-pressure switch. A loss of charge shall be detected by a low-pressure safety.

D. The coaxial water-to-refrigerant heat exchanger shall be constructed of a convoluted copper(optional cupronickel) with a designed refrigerant working pressure of 450 PSIG (3100 kPa) and a designed water side working pressure of no less than 400 PSIG (2750 kPa). Due to their susceptibility to fouling, plate heat exchangers are not acceptable. The fluid-to-refrigerant heat exchangers shall be insulated to prevent condensation at low fluid temperatures.

E. The refrigerant tubing shall be 99% pure copper. This system shall be free from contaminants and conditions such a drilling fragments, dirt and oil.

F. The system's water inlet and outlet for the source connections shall be female NPT composed of copper. Service and caution labels shall be placed on the unit in their appropriate locations.

2.04 SAFETY DEVICES

A. Provide the following safety devices:
1. Unit shutdown in low/no water flow condition.
2. Low air and water temperature sensors.

PART 3 EXECUTION

3.01 INSTALLATION OF HEAT PUMPS

A. Install heat pumps where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

3.02 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.03 ELECTRICAL

A. Controls and safety devices will be factory wired and mounted with the unit.

B. Controls shall include compressor contactor, 24V transformer, reversing valve coil, lock-out relay and low pressure bypass timer (or a solid-state device incorporating the functions of these two components) to prevent nuisance low pressure lock-outs during operation with low fluid temperatures.

C. A terminal block with screw terminals shall be provided for control wiring. When safety controls are activated the lock-out circuit must be reset at the aquastat or main circuit breaker to prevent compressor operation during fault conditions.

D. A lock-out indicating terminal shall be provided in the low voltage circuit.

E. Safety devices include a low pressure cutout set at 20 PSIG (140kPa) for loss of charge protection and a high pressure cutout control set at 380 PSIG (2600 kPa). An optional energy management relay to allow unit control by an external source shall be factory installed.

3.04 TRAINING

A. Provide two hours on-site training by a factory authorized service technician. Confirm proper operation and serviceability has been maintained. Schedule training in coordination with engineer.

END OF SECTION

SECTION 238268

CAST IRON SECTIONAL BOILER AND BOILER BURNER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 CODES AND STANDARDS

A. The burner shall be UL approved and installed in accordance with state and local codes and the NC Department of Labor Boiler and Pressure Vessel Division.

1.03 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating where applicable), furnished specialties and accessories; and installation and start-up instructions.

PART 2 PRODUCTS

Manufacturer: Boilers shall be model 888 as manufactured by Weil McLain or equal by Peerless or Smith.

2.01 BOILER

A. Furnish and install sectional cast iron hot water boiler, or equal, gross I-B-R output as scheduled on the drawings, firing oil or natural gas with positive draft, category 3 venting. Boiler shall include:

1. 50 psi ASME rated pressure relief valve.
2. Combination water pressure and temperature gage.
3. Combination low temperature limit (operating) and manual reset high temperature limit control.
4. Low water cut-off to prevent burner operation when boiler water falls below safe level.
5. Operating temperature controller to maintain boiler water temperature.
6. Cast iron sections with 80 psi ASME Boilers and Pressure Vessels Code rating, assembled with push nipples or gaskets and draw rods.
7. Flame observation ports
8. Access to flue passages for cleaning.

B. Structural Base: Aluminized steel lined with high temperature mineral fiber insulating panels.

C. Jacket: 3” glass fiber insulated steel jacket, finished with factory applied baked enamel.

2.02 BURNER FEATURES

A. Furnish and install one UL labeled, fuel oil burner. Burner shall be Webster JB series, or equal by Power Flame or Gordon-Piatt. Firing ratings shall be based

on balanced pressure flue.

B. All combustion air shall be furnished by the burner fan which shall be an integral part of the burner.

C. The oil burner shall burn the specified quantity of fuel without objectionable noise, vibration or pulsation with not more than 15% excess air and no CO in the products of combustion on oil firing.

D. The burner shall incorporate a stainless steel flame retention type combustion head for long life and efficient operation. Burners which have refractory or cast iron type combustion heads will not be approved.

E. The burner is to be equipped with a heavy welded steel blower housing with integral fan scroll.

F. A permanent observation port shall be provided in the burner to allow observation of both the pilot and main flame.

G. Supply voltage available will be 460 V, 3 PH, 60 HZ and 120 V, 1 PH, 60 HZ. All motors and overloads shall be suitable for use on this voltage. All burner controls

shall be for use with 120V 1PH 60HZ

2.03 BURNER CONTROLS

A. The modulating operation of the burner shall be controlled by water temperature by means of a temperature control.

B. An additional high limit safety pressure control of the manual reset type shall be provided to control the burner.

C. Pre- and post-purge operation of the burner fan shall be provided.

D. A manual restart of the burner shall be necessary in the event of shutdown due to flame failure.

E. All motors shall be controlled and protected by an automatic starter with overload protection. Starter shall be interlocked to prevent burner operation when overload relays are tripped out.

F. Supply a burner mounted air flow switch to prevent the energization of the main fuel valves in the event of insufficient combustion air.

G. Manual reset of system shall be required to restart burner after a combustion air flow failure has occurred.

H. The control cabinet(s) shall house the flame safeguard control, programming purge timer, burner motor starter, fuses, control switches, alarm bell with automatic reset silencing switch to ring on low water or flame failure, control transformer, indicating lamps as specified and relays that may be required

I. The burner shall be equipped with suitable fuel and air controls to assure smooth main flame ignition.

J. Low-fire start shall be provided for ignition of fuel. Pre-ignition purge air flow rate shall be

no less than 60% maximum firing rate air flow. Full modulation operation of fuel shall be provided. An integral temperature control shall modulate the burner to best meet varying system load conditions. When the operating control is satisfied the burner shall shutoff and shall return to the low fire start position.

K. An electronic safety combustion control shall be supplied complete with scanner to monitor the pilot and main flames. It shall be utilized to provide an interrupted type electric ignition and pre-ignition purge timer. The scanner shall detect the ultraviolet radiation.

PART 3 EXECUTION

3.01 INSTALLATION

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

B. Install in accordance with NFPA 54.

C. Install boiler on new concrete housekeeping base.

D. Provide connection of fuel oil in accordance with NFPA 54.

E. Provide piping connections and accessories as indicated; refer to Section 15510.

F. Pipe relief valves to nearest floor drain.

G. Provide for connection to electrical service.

H. Install burner and accessories as indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure that burner and accessories comply with requirements and serve intended purposes. Comply with requirements of state and local boiler codes, applicable portions of ASME Boiler and Pressure Vessel Code, and applicable portions of ASME B31.1 or ASME B31.9.

3.02 FIELD QUALITY CONTROL

A. Services: After testing and inspection is complete, provide the services of an authorized factory service representative to perform start-up and operation demonstration services. A copy of the start up report shall be included in the O&M manuals. The tests shall be run at both high and low fire and at least three tests per fire level to indicate the most efficient operation. As a minimum the start up report shall include:

1. CO_2
2. CO
3. O_2
4. NO_x
5. Ambient temperature
6. Stack temperature
7. Flame signal
8. Furnace pressure-draft
9. Excess air
10. Burner Amps
11. Burner efficiency
12. Test equipment used.

B. Final calculation for each burner shall be made which certifies gross output, gross input, and

flue oil loss. This shall be permanently labeled on burner.

C. In addition to the standard warranty, the manufacturer's representative shall provide a one year emergency service contract.

END OF SECTION

SECTION 238275

BREECHINGS, CHIMNEY, AND STACKS - CAST IRON SECTIONAL BOILER

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings, Instructions to Bidders and General Conditions of the Construction Contract, including Supplementary General Conditions and Division-l Specification sections, apply to work of this section.

1.02 SUBMITTALS

A. Manufacturer's Data: Submit product data including materials, dimensions, weights, and accessories.

1.03 QUALITY ASSURANCE:

A. Codes and Standards:
1. NFPA: Comply with NFPA 211 Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.
2. UL: Comply with applicable portions of UL safety standards, provide products which have been UL listed and labeled.

PART 2 PRODUCTS

2.01 BOILER VENT/STACKS

A. Factory-built vent/stack shall be laboratory tested and listed by the Underwriters Laboratories, Inc. for use with building heating equipment burning gas, solid or liquid fuels as described in NFPA 211, which produce exhausted flue gases at a temperature not exceeding 1400 deg F. under continuous conditions.

B. New boilers will use Category III smooth double wall flue pipe. The flue gas carrying pipe shall be 304 stainless steel alloy, .035" nominal thickness for all diameters. The outer jacket shall be aluminized steel inside the building, and 304 stainless steel outside the building. Joints must be of a design for Category III pressurized venting. Manufacturer's installation instruction must be on site and followed closely

C. Barometric dampers shall be of the same material as the vent pipe and designed for installation in the vent pipe.

D. When the breaching and chimney is installed according to the manufacturer installation instructions and the limits of its listing, it shall comply with national safety standards and building codes.

E. Inner pipe joints shall be sealed by use of V Bands and RTV Silicone Sealant for flue gas temperatures up to 600 deg. or as outlined in the installation instructions and supplied by the

manufacturer.

F. The stacks extending above roof surfaces or out walls must terminate as required by local code and manufacturer's instruction with factory roof caps or factory wall caps.

PART 3 EXECUTION

3.01 INSTALLATION OF FABRICATED BREECHINGS AND CHIMNEYS

A. Joints: Weld joints in conformance with AWS workmanship standards of AWS D9.1, Specification for Welding Sheet Metal.
1. Align breechings accurately at connections, with a smooth internal surface and a 1/8" misalignment tolerance.
2. Slope breechings down slightly to appliances.
3. Anchor breechings to building structure with bolts, concrete inserts, steel expansion anchors (not lead-shield type), welded studs, C-clamp or special beam-clamps.

B. Vertical Breechings:
1. Support at 12 foot intervals, by attachment to adjacent vertical structural surfaces or by direct bearing at floor penetrations and similar locations.
2. Breechings up to 24" x 20": Use 1-1/2" x 16 gage strips or formed angles.
3. Breechings larger than 25" x 20": Use steel angle brackets 1" x 1/2" for sizes up to 36", 1-1/2" x 1" for larger sizes.
4. Horizontal breechings located against structural walls and other similar adjacent vertical surfaces.
5. Support at 8 foot intervals for units up to 40" horizontal dimensions, and 4 foot intervals for larger breechings. Where width is less than height: support with 1-1/2" x 16 gage straps.
6. Where width is more than height: support with shelf-type fabricated angle brackets; 1" x 1/8" for widths up to 18"; 1-1/2" x 1/8" for greater widths.

C. Horizontal Rectangular Breechings:
1. Support from overhead structure with hangers at 10 foot intervals for unit widths up to 60", and 8 foot intervals for larger breechings.
2. Support breechings directly with 1" x 16 gage straps up to 60" width, and with 1-1/2" x 12 gage straps up to 96" width, bolted to breechings.

D. Horizontal Round Breechings:
1. Support with girth strap and strap hanger (of same size); except for sizes over 50" in diameter. Install pair of strap hangers bolted to opposite sides of angle reinforcing rings or flanged joints. Support breechings at 10 foot intervals with hangers as follows for corresponding diameters.
   Up to 30" diameter: 1" x 16 gage strap hangers.
   31" to 50" diameter: 1-1/2" x 16 gage strap hanger.
   51" to 84" diameter: Pairs of 1-1/2" x 16 gage strap.

3.02 INSTALLATION OF DAMPERS

A. Install barometric dampers in accordance with manufacturer's instructions. Locate at approximately 10' AFF.

3.03 ADJUSTING AND CLEANING

A. Clean breechings internally during installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 260050

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. All work, materials, etc., shall be furnished and installed, whether or not specifically shown on the drawings and/or called for in the specifications, which may be necessary to comply with all of the requirements, due to the exigencies of the work, to complete the work and the contract in a satisfactory and approved manner.

B. The work to be done under this contract shall consist of furnishing all equipment, labor, materials required for the items listed in the proposal, and/or as shown on the contract drawings, together with all devices, connectors, splices and appurtenances, required for a safe, clean, complete and ready for service, reliable, substantial and rugged working installation, to the satisfaction of the Engineer and to execute the intent of this contract and these specifications.

C. The Contractor shall be responsible for determining the proper connection points for all power, control, and signal wiring installed under this contract, regardless of whether the connection points are in equipment furnished under this contract, existing equipment, or equipment furnished by others. The Contractor shall include in his bid prices any field surveys, wire tracing or other work required to ascertain the proper connection points for all wiring.

D. It is the intent of these specifications that the Contractor shall furnish equipment and material which is suitable for the purpose and for installation in the location as is.

E. It is also the intent of the specification that the equipment, materials and accessories, as furnished, shall be complete in all respect and ready to operate.

F. The specifications cover the general design, construction arrangement, and certain particular features, but do not purport to cover all details entering into the design of the equipment and accessories.

G. Minor revisions in construction details will be made to accommodate equipment proposed and approved on the drawings thereof, submitted by the Contractor. Major revisions shall not be made nor shall equipment be submitted for approval which cannot be installed in structures of the approximate dimensions and character specified herein.

H. Further, it is also the intent of these specifications to provide a complete contract including items which may be omitted or not shown but which are considered normal and accepted engineering practice for this type of contract at no additional cost to the Owner.

I. All work shall be done in a thorough and workmanlike manner and shall conform to the best modern practice in the manufacture and installation of high-grade equipment and materials. Wherever possible, all parts shall be made according to standard gauge to facilitate replacement and repair.

J. All materials furnished under these items shall be the best of their respective kinds and shall be free from defects in design and workmanship.

K. All materials or equipment not meeting the specified requirements shall be rejected, and shall be replaced at once by the Contractor with materials or equipment of the specified type and quality, at no cost to the Owner.

L. All materials for which no detailed specifications are given herein shall be of the quality and character best adapted and suitable for the purpose for which they are to be used and shall be subject to the approval of the Engineer.

M. Where any material or article or the maker or distributor thereof is specified by name, this is done for the purpose of more clearly describing the type or quality desired. Any material or article of equal quality, merit and performance, in the opinion of the Engineer, will be acceptable, if approval is given in writing.

N. All materials furnished and work done by the Contractor shall be subject to the inspection of the Engineer. Defective materials shall be removed from the site of the work and defective work repaired or replaced as directed. Facilities for handling and inspection of materials and equipment and for access to the work in progress shall at all times be furnished by the Contractor.

O. Where any delay is encountered in carrying out work due to unfavorable operating conditions, the Contractor shall not be entitled to additional compensation therefore, but the time allowed equivalent to the period of actual delay.

1.02 DESCRIPTION OF WORK

A. Work includes all labor and electrical labor and equipment to install the project as represented in the drawings and specifications.

B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.

C. Include in the work, all accessories and devices necessary for the intended operation or perfection of any system, whether or not specifically shown or specified.

D. The term ″Furnish″ shall mean to obtain and supply to the job site. The term ″Install″ shall generally mean to fix in position and connect for use. Where language indicates that one party or trade is to ″install″ and another is to ″connect″, the term ″install″ shall mean only to fix in position, and ″connect″ shall mean to make electrical connections to. The term ″Provide″ shall mean to furnish and install.

E. Furnish all documentation, such as shop drawings, as-built drawings, and operation and maintenance manuals, certify and perform all required testing as herein specified.
   1. Testing & Start-Up: Assist MC in startup of all equipment. Provide As-Built Documentation, start-up and test protocol.
   2. As Built Documentation: Provide a minimum of (4) sets of Ring Binders per each system with the following minimal content:
      a. Electrical As Built Drawings
      b. Equipment Data/Specification sheets and Operating Manuals and fuse sizes by equipment.
      c. List of lighting lamps by fixture

F. Provide all items as called out in “Scope of Work” on drawings.

1.03 STANDARD OF QUALITY

A. The specifications establish the standards of quality required, either by description or by references, to brand name, name of manufacturers or manufacturer's model number. All materials shall be new unless noted otherwise.

B. Where one product only is specifically identified by name or manufacturer's model number, the Contractor shall base his bid on the use of the named product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named.

C. The Contractor may submit, with his bid, the names of products which are proposed as substitutions for products named in the specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.

D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.

E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

1.04 SUBMITTALS

A. Engineer’s review of shop drawings is solely for the benefit of the Owner and in no way relieves the contractor from his obligations to furnish materials which satisfy the requirements of his contract and the design intent.

B. Shop drawings, product data and samples shall be submitted as required by the General Conditions or Project Requirements and as supplemented by this section.

C. When a specific specification section identifies that no submittal is required, the contractor shall provide the specified materials without submittals.

D. Provide to the Engineer, a schedule of shop drawing submissions identifying submittal target dates.

E. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.

F. The Contractor shall check and verify pertinent field measurements, and quantities of equipment and materials required.

G. Submittals shall be identified by reference to the drawing(s), section(s) of specifications, or equipment symbols to which they relate.

H. Shop drawings, when required, shall include:
1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
2. Equipment layouts drawn to scale as may be required.
3. Wiring diagrams and schematics for equipment.
4. Any special construction conditions.
5. Other information/data as may be requested.

I. All submittals shall identify the specific details of the product or assembly. All optional features being provided or proposed shall be so noted or the submittal will be rejected.

J. The Engineer will return submittals with one of the following notations stamped thereon; REVIEWED, REVIEWED AS NOTED, REVISE AND RESUBMIT, REJECTED or SUBMIT SPECIFIED ITEM AND THE FOLLOWING:

1. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for:
   a. dimensions which shall be confirmed and correlated at the job site
   b. fabrication processes and techniques of construction
   c. coordination of his work with that of all other trades
   d. the satisfactory performance of his work.
2. The work involved may proceed when submittals are marked REVIEWED or NO EXCEPTIONS TAKEN with no further submission required.
3. The work involved may proceed when submittals are marked REVIEWED AS NOTED, providing corrections are made and submittals are resubmitted for record. Review does not authorize changes to Contract Sum unless stated in a separate letter or Change Order. In the event that any notes placed on the submittals by the Engineer are believed to result in a change in the Contract Sum, the Engineer shall be notified immediately and fabrication may not be undertaken until written authorization to proceed is issued by the Owner.
4. The work involved may not proceed when submittals are marked REVISE AND RESUBMIT. Submittals must be corrected and resubmitted for review.
5. Submittals marked REJECTED OR SUBMIT SPECIFIED ITEM are not in accordance with the Contract Documents and require a new submittal for review.
6. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

1.05 PROTECTION OF WORK

A. Each Contractor is responsible for the protection of his materials, equipment, and completed work as defined in the General or Project Requirements and as supplemented herein.

B. All openings into any part of the conduit systems, all fixtures and equipment must be securely covered or otherwise protected to prevent damage due to dropped tools or materials, work by others or intrusion of grit, dirt, water, snow, ice or other foreign matter. Remove burrs, dirt, paint spots and debris. The Contractor shall be held responsible for all damage done to unprotected work or materials.

1.06 STEEL AND CONCRETE WORK FOR ELECTRICAL EQUIPMENT

A. Steel: Provide all miscellaneous steel supports and anchors required for equipment and materials installed under this Specification. Manual of Construction by American Institute of Steel Construction latest edition shall be followed in design and construction except that the second sentence of paragraph 4.2.1., Section 4 of Division 5, page 5-177 will not apply. Structural steel members shall conform to ASTM A36, and shall have a shop applied coat of rust inhibiting paint. Welding of steel shall conform to American Welding Society, Standard Code for Arc and Gas Welding in Building Construction. Bolts, nuts and washers for structural steel framing and concrete embedment shall be high tensile type minimum 3/4" diameter conforming to ASTM A325. Slotted-steel channel

supports shall have flange edges turned toward web, and 9/16 inch diameter slotted holes at a maximum 2 inches o.c., in webs.

B. Channel depth: 2-1/2 inches minimum.

C. Channel thickness: Selected to suit structural loading.

D. Fittings and Accessories: Products of the same channel manufacturer.

E. Channel supports and fittings shall be hot dip galvanized steel.

F. Concrete work and anchors: Refer to for concrete work and anchors.

1.07 COUNTERFLASHING

A. Where conduits or other items pass through any roof, wall or other exterior component, provide counter flashing as required.

1.08 EQUIPMENT BY OTHERS

A. Summary of Work, together with other technical sections in the Project Manual, describe equipment that will be furnished by the Owner or from other sources.

B. The responsibility for setting, installation and protection of such equipment will be defined in other sections of the Project Manual.

C. Provide services rough-in for and make final connections to this equipment as shown and specified.

D. Provide coordination to assure clearances required for moving equipment to final location.

1.09 MOVING OF EQUIPMENT

A. Verify that electrical equipment will pass through all restricting openings, and when equipment or sections of equipment are larger than these openings, install this equipment prior to construction of enclosing walls, floors or roofs.

B. Use planking or cribbing as required to protect adjoining construction from damage.

C. Provide rigging and expert rigging personnel as required for equipment installation in difficult locations. Rigging shall include any necessary structural investigation and temporary structural support.

1.10 CUTTING AND PATCHING

A. Provide all openings through walls, floors and ceilings, etc. required for the installation of work defined on the drawings and specifications.

B. Following installation and testing, restore floors, walls and ceilings with materials equal to the original construction and finish to match existing surfaces.

C. Cutting and patching shall be performed only by tradesmen familiar with the construction

involved.

1.11 IDENTIFICATION

A. Nameplates:
1. Provide each new normal power load break switch, automatic transfer switch, starter, circuit breaker, panel, remote start-stop station, pilot light or safety switch with an engraved laminated black and white phenolic nameplate, white letters on black background.
2. Provide Fire Alarm panels with an engraved laminated red and white phenolic nameplate, white letters on red background.
3. Compose the legend so as to clearly indicate the function of the equipment. Letters and numbers to be at least 3/16 inch high.
4. Locate the nameplate in a position so as to be clearly visible and secure with screws. Rivets and adhesives are not acceptable.
5. Submit proposed nameplate legend for review.
6. Provide a nameplate on the main switchgear indicating names of the electrical contractor and the engineer and project year.

1.12 FINAL ACCEPTANCE

A. The Contractor shall perform and complete work in accordance with the Contract Documents without fault or defect of any kind. In the absence of more specific directives, the work shall:
1. be completed in a first class manner.
2. be placed in a thoroughly clean and unmarred condition.
3. be checked out in a step-by-step manner to ascertain that fastenings, controls, parts, safety devices, operating devices and other required appurtenances have been provided in accordance with the Contract Documents.
4. be free of previously condemned or rejected parts and be properly restored to an acceptable condition.
5. be adjusted for proper operation wherever adjustments or calibrations exist in the work.

B. All systems shall be operated to demonstrate that the requirements of the Contract have been met and that the systems have been adjusted and will operate in accordance therewith.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish for review, three hard bound copies of complete written instructions for the operation, care and maintenance of each piece of equipment and/or system. Include recommended frequency of inspection, cleaning, oiling, greasing, and adjustment and other action as may be required in accordance with manufacturer's recommendations. Material shall include manufacturer's brochures, catalog cuts, parts lists, wiring diagrams, service organizations, etc.

1.14 PERMITS, FEES AND CERTIFICATES OF APPROVAL

A. Contractor shall acquire all permits and certificates. Submit a final inspection certificate from Middle-Atlantic Inspections or other NFPA affiliated agency with request for final payment.

B. Contractor shall provide all power, labor and instruments required for tests and cleaning of systems.

C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer.

D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of test dates.

1.15 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:

1. American Society for Testing and Materials (ASTM)
2. American National Standard Institute (ANSI)
3. Underwriter's Laboratories, Inc. (UL)
4. American Welding Society Code (AWSC)
5. NFPA 70, ″National Electrical Code″, latest edition
6. National Electrical Manufacturer's Association (NEMA).
7. Occupational Safety and Health Act (OSHA).
8. National Fire Protection Association (NFPA).
9. National Electrical Safety Code (NESC)
10. North Carolina Building Code, latest edition
11. Institute of Electrical and Electronics Engineers (IEEE)
12. Illuminating Engineering Society of North American (IESNA)
13. State and Local Building, Electric, and Fire Codes and Regulations.

1.16 PAINTING

A. Cabinet trims and similar prefabricated equipment shall be factory primed and finish painted with baked enamel in color selected. This equipment shall not be painted in the field unless the factory finishes have been marred or as otherwise directed. Do not paint over UL or similar labels or mechanical/electrical nameplates.

1.17 COORDINATION OF WORK

A. Coordinate installation of conduit runs and equipment with other trades and conditions in the building and participate in all coordinated shop drawings. Variance from work shown on drawings will be subject to approval. Where interference occurs and electrical work is directed to be relocated, provide such relocation without additional cost.

B. It is the Electrical Contractor’s responsibility to coordinate with the manufacturers of all new and existing pieces of equipment the different aspects of their interfaces. All additional costs for equipment manufacturer’s redesign of interfaces caused by the EC’s failure to properly coordinate all aspects of the interfaces shall be borne by the EC.

1.18 ACCESS PANELS

A. Furnish access panels where required, to concealed pull boxes, junction boxes, or similar equipment located above dry wall board ceiling or behind walls. Installation of access panels shall be by mechanics of the pertinent trade under General Construction.

B. Access panels shall be 18" x 18" minimum, 16 gage wall or ceiling frame and a 14 gage panel door with not less than 1/8" fire proofing secured to the inside of the door.

C. The door shall be provided with concealed hinges and cylinder lock, and prime-coated steel prepared for painting. Each door shall be capable of opening 180 degrees.

D. Doors for wall panels shall be secured with suitable clips and counter sunk tamperproof screws.

E. Access panels shall have "label" fire rating equal to the ceiling or wall surface.

1.19 WARRANTY

A. The contractor and equipment manufacturers shall jointly guarantee all wiring and equipment to be free of defects in workmanship and material for a period of one year from the date of final acceptance, unless otherwise noted.

1.20 PROJECT RECORD DOCUMENTS

A. Maintain at job site, one copy of record documents and samples as required under the General Conditions of the Contract, including Drawings, Specifications, Addenda And Bulletins, Change Orders, Shop Drawings, Product Data and Samples, Field Orders, Field Test Records and Maintenance and Operating Manuals.

B. Provide files and racks for storage of documents. Maintain documents in a clean, dry legible condition and in good order. Do not use record documents for construction purposes. Make record documents and samples available during normal working hours for inspection.

C. Recording:
1. Label each document ″Project Record″ in neat large letters and provide final completion date.
2. Record information concurrently with construction progress.
3. Do not conceal any work until required information is recorded.

D. Record Drawings - legibly mark to record actual construction as follows:
1. A print set (blue-line or black-line) of contract drawing or shop drawing mark-ups of actual installations which vary substantially from the work as originally shown. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawing are used for mark-up, record a cross reference at corresponding location on working drawings. Mark with red erasable pencil and, where feasible, use other colors to distinguish between variation in separate categories or work. Mark-up new information which is recognized to be of importance to Owner, but was for some reason not shown on either contract drawings or shop drawings. Give particular attention to concealed work which would be difficult to measure and record at a later date. Note related change order numbers where applicable.
2. Record Specifications and Addenda, Bulletins, Requests for Information (RFI's) and Construction Clarification Sketches (CSK's) - legibly mark each Section to record:
   a. Any variations in actual work in comparison with text of specifications
   b. modifications as issued. Give particular attention to substitutions, selection of options, and similar information where work is concealed or cannot otherwise be readily discerned at a later date by direct observations. Note related record drawing information and product data, where applicable.
   c. Changes made by Field Order or by Change Order.

E. Product Data: Maintain one copy of each product data submittal, and mark-up significant variation in actual work in comparison with submitted information.
1. Include both variations in product as delivered to site, and variations from

manufacturer's instruction and recommendations for installation.

2. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observations. Note related change orders and mark-up of record drawings and specifications.

F. Record Drawings Submittal at Project Completion: Organize record drawing sheets into manageable sets, bind with durable paper cover sheets and print suitable titles, dates and other identification on cover of each set. Transfer marking required by previous paragraphs to set of reproducible transparencies. Submit complete set of transparencies to the Design Professional and two sets of blue-line prints.

G. Product Data Submittal at Project Completion: Submit three sets of marked-up product data submittals for record purposes that include resolution of all review notes and field revisions.

H. Miscellaneous Record Submittals: Refer to other sections of these specifications for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the works. Immediately prior to date(s) of substantial completion, complete miscellaneous records and place in good order properly identified and bound or filed, ready for continued use and reference. Submit to Architect/Engineer for Owner's records.

I. Maintenance Manuals: Organize maintenance-and-operating manual information into three suitable sets of manageable size, and bind into individual binders properly identified and indexed (thumb-tabbed). Include:

1. emergency instructions
2. spare parts listing
3. warranties
4. wiring diagrams
5. recommended "turn-around" cycles
6. inspection and cleaning procedures
7. recommended frequency of testing, adjustment and any other maintenance requirements
8. shop drawings
9. product data
10. similarly applicable information.

J. Bind each manual of each set in heavy duty 2-inch, vinyl-covered ring binder, and include pocket folders for folded sheet information. Mark identification on both front and spine for each binder

END OF SECTION

SECTION 260075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.03 SUBMITTALS

A. No submittals.

1.04 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70, 2017

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 PRODUCTS

2.01 RACEWAY AND CABLE LABELS

A. Color: Black letters on orange field.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend over-laminated with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

2.02 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, pre-printed, cellulose acetate butyrate signs with 0.0396-inch (1-mm) galvanized steel backing; and with colors, legend, and size required for the application. 1/4 inch (6.4-mm) grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.03 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:
   1. Clean surfaces of dust, loose material, and oily films before painting.
   2. Prime surfaces using type of primer specified for surface.
   3. Apply one intermediate and one finish coat of enamel.

F. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:
      a. Fire Alarm System: Red.
      b. Fire-Suppression Supervisory and Control System: Red and yellow.
      c. Combined Fire Alarm and Security System: Red and blue.
      d. Security System: Blue and yellow.
      e. Mechanical and Electrical Supervisory System: Green and blue.
      f. Telecommunication System: Green and yellow.

G. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.

H. Circuit Identification Labels on Boxes: Install labels externally.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.
   3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

I. Color-Coding of Secondary Phase Conductors: Use the following colors for service feeder, and branch-circuit phase conductors:
   1. 208/120-V Conductors:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue
   2. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
      a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
      b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to the indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

K. Apply identification to conductors as follows:
1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

L. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
2. Access doors and panels for concealed electrical items.
3. Disconnect switches.
4. Enclosed circuit breakers.
5. Motor starters.
6. Remote-controlled switches.
7. Control devices.

END OF SECTION

SECTION 260080

ELECTRICAL TESTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:
   1. Qualifications of testing agencies and their personnel.
   2. Suitability of test equipment.
   3. Calibration of test instruments.
   4. Coordination requirements for testing and inspecting.
   5. Reporting requirements for testing and inspecting.

B. Electrical tests and inspections specified in various Division 26 and 28 Sections shall be provided with the contract by the appropriate manufacturer's reps. and electrical contractor.

1.03 QUALITY ASSURANCE

A. Testing Agency Qualifications: As specified in each Section containing electrical testing requirements and in subparagraph and associated subparagraph below.
   1. Independent Testing Agencies: Independent of manufacturers, suppliers, and installers of components to be tested or inspected.
      a. Testing Agency's Field Supervisor for Power Component Testing: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Division 16 power component Sections.

B. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

C. Test Equipment Calibration: Comply with NETA ATS, Section 5.3.

PART 2 NOT USED

PART 3 EXECUTION

3.01 GENERAL TESTS AND INSPECTIONS

A. If a group of tests are specified to be performed by an independent testing agency, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready for

independent agency testing. Include the following minimum preparations as appropriate:

1. Perform insulation-resistance tests on all service and feeder cables.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 240/120-V electrical power for test instrumentation at each test location.
5. Provide service ground resistance test, see 260510.

B. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:

1. Manufacturer's written testing and inspecting instructions.
2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

END OF SECTION

SECTION 260120

CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.03 SUBMITTALS

A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.04 QUALITY ASSURANCE

A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
   1. The Terms □Listed□ and □Labeled□ as defined in NDPA 70, Article 100.
   2. Listing and Labeling Agency Qualifications: A □Nationally Recognized Testing Laboratory□ as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver wires and cables according to NEMA WC 26.

1.06 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Engineer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 CONDUCTORS AND CABLES

A. Manufacturers:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Rome Cable Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THHN-THWN, XHHW and XHHW-2 complying with NEMA WC 5 or 7.

E. Multiconductor Cable: MC/Armored cable with ground wire.

F. NM cable is not permitted.

G. Aluminum alloy wires are allowed in 100 Amp and larger feeders with use of crimp connectors and conductive, anti-corrosive termination grease.

2.03 CONNECTORS AND SPLICES

A. Manufacturers:
1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 CONDUCTOR AND INSULATION APPLICATIONS

A. Underground Service Entrance: Type XHHW-2, single conductors in raceway. Aluminum alloy conductors, with crimp termination lugs and conductive termination grease, is allowed.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type XHHW-2 single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN,

single conductors in raceway or flexible metal conduit where permitted for connections to devices not exceeding 3’ in length. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

G. Branch circuit homeruns exposed or concealed: Type THHN-THWN, single conductors in EMT or RMC.

H. Flexible metal conduit shall be used at all equipment locations subject to vibration. Length shall not exceed 6’ for power feeds and 36” for control devices.

I. Multi-conductor Cable: MC/Armored cable is permitted only for whips to lighting fixtures, fishing in to individual devices in existing walls where EMT installation is not feasible, and where specifically approved by the Engineer or Architect.

3.02 INSTALLATION

A. Conceal conduits in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 260500 Section "Common Work Results."

F. Seal around cables penetrating fire-rated elements according to Division 078400 Section "Firestopping."

G. Identify and color-code conductors and cables according to Division 260075 Section "Electrical Identification."

3.03 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260130

RACEWAYS AND BOXES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

B. Related Sections include the following:
1. Division 3 Concrete for exterior ductbanks, manholes, and underground utility concrete work.
2. Division 078400 Section "Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 260500 Section "Common Work Results" for supports, anchors, and identification products.
4. Division 262726 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. LFNC: Liquidtight flexible metal conduit.

G. RMC: Rigid Metal Conduit.

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.06 COORDINATION

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 METAL CONDUIT AND TUBING

A. Manufacturer:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.
   5. Grinnell Co. /Tyco International; Allied Tube and Conduit Div.
   6. LTV Steel Tubular Products Company.
   7. Manhattan/CDT/Cole-Flex.
   8. O-Z Gedney; Unit of General Signal.
   9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT and Fittings: ANSI C80.3.
   1. Fittings: Compression type.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.03 METAL WIREWAYS

A. Manufacturer:
   1. Hoffman
   2. Square D

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to

comply with NFPA 70.

E. Wireway Covers: Screw cover type, Flanged and gasketed type at exterior.

F. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard grey finish coat.
   1. Manufacturer:
      a. Walker Systems, Inc.; Wiremold Company (The).
      b. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.05 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company
   3. Erickson Electrical Equipment Co.
   4. Hoffman
   5. Hubbell, Inc.; Killark Electric Manufacturing Co.
   6. O-Z/Gedney; Unit of General Signal
   7. RACO; Division of Hubbell, Inc.
   8. Robroy Industries, Inc.; Enclosure Division
   9. Scott Fetzer Com.; Adalet-PLM Division
   10. Spring City Electrical Manufacturing Co.
   11. Thomas & Betts Corporation. Walker Systems, Inc.; Wiremold Company
   12. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.06 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components: provide manufacturer's standard prime-coat finish ready for field painting.

B. Finish: For raceway, enclosure, or cabinet components: provide manufacturer's standard gray paint applied to factory-assembled surface raceways, enclosures, and cabinets before shipping.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors:
1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures: NEMA 250, Type 3R or 4.

B. Indoors:
1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4.
6. Where subject to damage, use rigid steel or IMC.

C. Minimum Raceway Size: 3/4-inch.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

3.02 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 260510 Section "Common Work Results."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
   1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   2. Space raceways laterally to prevent voids in concrete.
   3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   4. Change from nonmetallic tubing to rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.
   1. Use insulating bushings to protect conductors.

K. Terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

M. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller. In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

N. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

O. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and

semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

P. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

Q. Set floor boxes level and flush with finished floor surface.

R. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

S. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

T. Flexible Metal Conduit may only be used in existing walls or for short, 6' max., connections to equipment or lights.

U. All conduit to be run concealed except where specifically reviewed and approved by owner.

V. All boxes shall be recessed wherever feasible.

3.03 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.04 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 260410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers, rated 600 V and less, used for disconnecting and protection functions.

B. See Division 16 Section "Fuses" for fuses for fusible disconnect switches.

1.02 SUBMITTALS

A. Product Data: For each type of switch and circuit breaker indicated.

B. Shop Drawings: Include wiring diagrams for shunt-tripped circuit breakers.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.03 QUALITY ASSURANCE

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

B. Source Limitations: Obtain switches and circuit breakers through one source from a single manufacturer.

C. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Retain above for nonproprietary or below for semi-proprietary specification. Refer to Division 1 Section "Product Requirements."

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Corp.; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D Co.
4. Bussmann; Power Module Switch.

2.02 ENCLOSED SWITCHES

A. Enclosed, Non-fusible Switch: NEMA KS 1, Type GD, with lockable handle, interlocked with cover.Edit below to indicate Project requirement for bolted-pressure contact switch, and high-pressure butt contact switch, or use Division 16 Section "Fused Power Circuit Devices" to specify these switches.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type GD, with clips to accommodate specified fuses, and lockable handle, interlocked with cover.

2.03 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.04 ENCLOSURES

A. Listed for environmental conditions of installed locations, including:
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Food Service Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 INSTALLATION

A. Temporary Provisions: Remove temporary lifting provisions and blocking of moving parts.

B. Identify components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."

3.02 FIELD QUALITY CONTROL

A. Testing: After installing disconnect switches and circuit breakers and after electrical circuits have been energized, demonstrate product capability and compliance with requirements.

B. Inspections and Tests for Switches and Circuit Breakers: Make internal and external inspections and perform tests, including the following:
   1. Inspect for freedom from physical damage, proper unit rating, mechanical condition, enclosure integrity, cover operation, unit anchorage, clearances, and tightness of electrical connections. If a loose electrical connection is observed on any unit, check each electrical connection for each switch and circuit breaker with a torque wrench for compliance with manufacturer's torquing instructions.
   2. Test insulation resistance of each pole, phase-to-phase, and phase-to-ground, following manufacturer's written instructions. Test insulation resistance of shunt trip circuits. Use 500-V minimum test voltage for units and circuits rated up to 250 V, 1000-V minimum test voltage for units rated more than 250 V. Measured insulation resistance must be 25 megohms, minimum, for switches rated up to 250 V, and 100 megohms, minimum, for switches rated more than 250 V.
   3. Test cover and other interlocks and interlock release devices for proper operation.

C. Additional Inspections and Tests for Switches: Include the following:
   1. Inspect for proper rating and fuse provisions.
   2. Check adequacy and integrity of fuse-holders by removing and installing fuses.
   3. Check integrity of phase barriers.
   4. Inspect blade alignment visually while operating switch to observe adequacy of blade pressure.

D. Additional Inspections and Tests for Circuit Breakers: Include the following:
   1. Inspect for proper frame, trip, and fault current interrupting rating.
   2. Test shunt trip devices, circuits, and actuating components for proper operation.

E. Correct defective and malfunctioning units on-site, where possible, and re-inspect and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
1. Supporting devices for electrical components.
2. Concrete equipment bases.
3. Cutting and patching for electrical construction.
4. Touchup painting.

1.03 QUALITY ASSURANCE

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

1.04 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

B. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.

D. Coordinate installing large equipment requiring positioning before closing in the building.

E. Coordinate electrical service connections to existing transformer.

F. Coordinate installation and connection of exterior underground utilities and services.

G. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Division 8 Section "Access Doors."

H. Coordinate electrical connections by mechanical contractor. Reference mechanical specification 230530, Section 1.2.

PART 2 PRODUCTS

2.01 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for use outdoors or in damp locations: Hot-dip galvanized steel.

C. Slotted Steel Channel Supports: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs.
1. Channel Thickness: Selected to suit structural loading.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Cable Supports for Vertical Conduit: Factory fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon steel wedge or sleeve type.

H. Toggle Bolts: All steel springhead type.

2.02 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc rich paint recommended by item manufacturer.

PART 3 EXECUTION

3.01 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot dip galvanized materials or nonmetallic, U channel system components.

B. Dry Locations: Steel materials.

C. Selection of Supports: Comply with manufacturer's written instructions.

D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

3.03 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze or bracket type galvanized hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Simultaneously install vertical conductor supports with conductors.

J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.

K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

M. All exposed support equipment shall be galvanized.

N. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts.
5. Light Steel: Sheet metal screws.
6. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof test load.

3.04 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing fire-stopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.05 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:
1. Supporting devices for electrical components.
2. Cutting and patching for electrical construction.
3. Touchup painting.

3.06 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint. Paint materials and application requirements are specified in Division 9 Section "Painting."
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.07 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish.

B. Remove burrs, dirt, paint spots, and construction debris.

C. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

D. Protect all open device boxes from painter’s sprays.

END OF SECTION

SECTION 260510

GROUNDING AND BONDING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.03 SUBMITTALS

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

B. Field Test Reports: Submit written test reports to include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.04 QUALITY ASSURANCE

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

B. Comply with UL 467.

PART 2 PRODUCTS

2.01 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 260120 Section "Conductors and Cables."

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Bare Copper Conductors: Comply with the following:
   1. Solid Conductors: ASTM B 3.
   2. Assembly of Stranded Conductors: ASTM B 8.
   3. Tinned Conductors: ASTM B 33.

F. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.02 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic welded type in kit form and selected per manufacturer's written instructions.

PART 3 EXECUTION

3.01 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
   2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the specified height above the floor.

3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install an insulated green copper equipment ground in all branch circuits and feeders.

3.03 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Conductors shall be in EMT conduit, bond conduit at both ends with approved bonding bushings and #6.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.

3.04 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a baregrounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturers published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following: Single and duplex receptacles, including ground fault circuit interrupters.
   1. Single and double pole snap switches.
   2. Device wall plates.
   3. Floor service outlets.

1.03 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Field quality control test reports.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

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

1.05 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations, minimum of NEMA 20 Amp.

B. Cord and Plug Sets: Match equipment requirements, minimum of NEMA 20 Amp.

PART 2 PRODUCTS

2.01 RECEPTACLES

A. Straight Blade Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight Blade and Locking Receptacles: Heavy Duty grade, 20 Amp.

C. GFCI Receptacles: Straight blade, non-feed through type, heavy Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.

D. Receptacles shall have separate hex-head grounding screw terminals.

E. Special purpose receptacles to match NEMA designations of various manufacturers' plugs.

2.02 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber insulated, stranded copper conductors, with Type SOW- jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.03 SWITCHES

A. Single, Double Pole, or 3 Way Switches: Comply with DSCC W-C-896F and UL 20.

B. Snap Switches: Heavy Duty grade, quiet type, 20 Amp.

C. Switches shall have separate hex-head grounding screw terminals.

2.04 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Brushed Stainless Steel.
3. Material for Unfinished Spaces: Galvanized steel, with rolled edges to match box size.
4. Material for Wet Locations: Thermoplastic with spring-loaded lift-cover, and listed and labeled for use in "wet locations" and "raintight while in use".

2.05 FINISHES

A. Color:
1. Wiring Devices Connected to Normal Power System: Grey, unless otherwise indicated or required by NFPA 70.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

C. Remove wall plates and protect devices and assemblies during painting.

D. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
Test GFCI receptacle operation with both local and remote fault simulations according to manufacturer's written instructions. Operation of the GFCI trip shall not interrupt power to any other receptacle on circuit unless otherwise noted.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 262813

FUSES

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

1.02 MAINTENANCE

A. Spare Parts:
1. Provide minimum of 10% spare fuses to owner's on site rep., not less than (2) of each size/type.
2. Special tools if required for installation or removal of fuses.

PART 2 PRODUCTS

2.01 FUSEHOLDERS

A. Equipment provided shall be furnished with fuse-holders to accommodate the fuses specified.

2.02 FUSES RATED 600V OR LESS

A. Fuses for Safety Switches (Lighting and Heating Circuits):
1. Cartridge Type (250 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
   a. Cooper Industries Inc./Bussmann Div., Type KTN-R
   b. Gould Inc./Circuit Protection Div. (Shawmut) Type A2K-R
   c. Littlefuse Inc. Type KLN-R

B. Fuses for Safety Switches (Motor Circuits):
1. Cartridge Type (250 Volts): Single element, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fuses, in identical sets, in readable orientation.

B. Verify that fuse clips fit tightly on fuse.

END OF SECTION