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94 Main Street
Canton, North Carolina 28716
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SPECIFICATIONS

FOR

HISTORIC COURTHOUSE

CHILLER REPLACEMENTS

HENDERSON COUNTY

HENDERSONVILLE, NORTH CAROLINA

November 16, 2021
November 29, 2021 (Revised)

NOTICE TO BIDDERS

Proposals will be received by the Henderson County Government, in the offices of Reece, Noland & McElrath, Inc., Engineers, 94 Main Street, Canton, NC 28716 up to 11:00 a.m., on December 22, 2021, and immediately opened for the furnishing of labor, material and equipment entering in the Historic Courthouse chiller replacements for Henderson County Government. Bids may be mailed to the address above, for receipt prior to bid date and time. A formal bid opening will not be held, so attendance by bidders is not required or expected. A bid tabulation will be issued summarizing the bids. Complete plans and contract documents will be available from the office of Reece, Noland & McElrath, Inc., Engineers, 94 Main Street, Canton, North Carolina.

A **mandatory** pre bid conference for BIDDERS will be held at 10:30 am on December 7**,** 2021 at the Historic Henderson County Courthouse, 1 Historic Courthouse Square #4, Hendersonville, NC. Everyone will meet in the parking lot behind the building at the chiller enclosure (off of North Church Street) then tour the facility. All Contractors planning to bid the project are required to attend this conference. The Scope of Work is to replace existing chiller serving the Historic Courthouse. New air cooled chiller will be installed to replace existing – re-connected to existing chilled water piping system, electric power, and building hvac controls system. Existing chiller injection (primary pump) will be replaced, as well. New chiller will be relocated in existing staggered-brick enclosure, after existing chiller is removed. Existing chiller will be disposed of by the contractor.

All contractors are hereby notified that they must have proper license under the state laws governing their respective trades. Contractors are notified that provisions of Chapter 87, General Statutes of North Carolina, will be observed in receiving and awarding contracts.

A single contract will be accepted for Mechanical work along with associated electrical work to connect power to new equipment.

See "Doing Business with Henderson County" for general information and Henderson County Insurance and Bond Requirements, Purchase Order/Contract Terms and Conditions Requirements, and Minority Business Participation Guidelines and Requirements at https://www.hendersoncountync.gov/county/page/doing-business-henderson-county

REQUIRED CONTRACTUAL PROVISIONS

Any proposal submitted to Henderson County shall be deemed to include all the Terms and Conditions shown in the document found online at https://www.hendersoncountync.gov/sites/default/files/fileattachments/henderson_county/page/42611/purchase_order_terms_and_conditions_rev_03-26-2019.pdf

These Terms and Conditions, which refer to a "purchase order", shall be deemed to be included in any contract entered into as a result of this Request for Proposals ("RFP"), even if the RFP seeks the provision of services or a mixture of services and goods instead of solely goods.

Any attempt by a proposed contracting party (the "Bidder") under the RFP to exclude any of these Terms and Conditions shall cause any Proposal made in response to this RFP to be deemed to be non-responsive (unless Henderson County has notified the Bidder that the funding source for the goods or work sought under this RFP is not federal funds, in which case those provisions under number 15 of the Terms and Conditions (and all subparts thereunder) may be excluded from a Proposal.

PUBLIC RECORDS

In any Proposal made under this RFP, any information claimed by a Bidder to be "confidential information", and any documents, memorandum, data, reports, analyses, compilations, records, pricing and evaluation of all or any portion of the transactions contemplated by this agreement may be deemed public records and subject to disclosure, in whole or in part, pursuant to the North Carolina Public Records Law. The County will provide the Bidder with reasonably prompt notice of any intended disclosures or requests for disclosure pursuant to the North Carolina Public Records Law. The Bidder may then choose to seek judicial protection of the confidential information consistent with all applicable laws and regulations. Should a public records request be made for information from

the Bidder, the County will, within a reasonable time, notify the Bidder of such public records request. The Bidder shall, within five (5) business days of said notification, deliver notice to the County that it objects to the County disclosing the requested information pursuant to the subject public records request. If no such notice is received by the County within five (5) business days, the Bidder shall be deemed to have waived any such objections. If the Bidder objects to the disclosure of the requested information, the Bidder agrees that it shall be solely responsible for the defense of and all the costs of the defense of any claim or complaint against the County for its refusal to disclose confidential information. The Bidder further agrees that if any such complaint or claim is filed it will indemnify the County and will reimburse the County for any and all damages awarded as a result of the refusal to disclose the requested information. The Bidder agrees that it releases the County from all loss, liability, claims or expense, including attorney's fees, arising out of or related to the release or disclosure or failure by the County to release or disclose confidential information. The Bidder further agrees that it waives the right to file any court action for any such release, disclosure, or failure to release or disclose confidential information.

Each proposal shall be accompanied by a bid bond of 5 per cent of the bid executed by a surety company licensed under the laws of North Carolina to execute such bonds, conditioned that the surety will upon demand forthwith make payment to the obligee upon said bond if the bidder fails to execute the contract in accordance with the bid bond. Performance Bond and Payment Bond will be required for one hundred per cent (100%) of the contract price. Payment will be made monthly on the basis of completion of work, with retainage in accordance with NC General Statutes 143-134-1.

No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 30 days.

As a party wishing to contract or otherwise do business with Henderson County, you must understand that you have a duty (imposed by North Carolina law in 2013), as a condition of payment for goods provided or services rendered, to comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes (E-Verify). Further, if you provide the goods or services to the County utilizing a subcontractor, you must require the subcontractor to comply with the requirements of Article 2 of Chapter 64 of the General Statutes as well. You are required to verify, by affidavit, compliance of the terms of this section upon the County's request.

Henderson County reserves the right to reject any and/or all bids, and to waive any bid informalities in so far as it is authorized to do so.

Any addenda to specifications issued during the time of bidding are to be considered covered in the proposal and in closing a contract they will become a part thereof. It shall be the bidder’s responsibility to ascertain prior to bid time the addenda issued and to see that his bid includes any changes thereby required. Should the bidder find discrepancies in, or omission from, the drawings or documents or should he be in doubt as to their meaning, he shall at once notify the Designer in writing who will send written instructions in the form of addenda to all bidders. Notification should be not later than seven (7) days prior to the date set for receipt of bids. Neither the Owner nor the Designer will be responsible for any oral instructions. All addenda shall be acknowledged by the bidders on the Form of Proposal. Requests for substitutions of materials or equipment shall be submitted by prospective bidders in writing to the Designer not later than seven (7) days prior to the date set for receipt of bids. Approvals to bid equivalent products will be issued in addenda.

HENDERSON COUNTY HISTORIC COURTHOUSE
CHILLER REPLACEMENTS
HENDERSONVILLE, NORTH CAROLINA

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INSTRUCTIONS TO BIDDERS

For a proposal to be considered it must be in accordance with the following instructions:

1. PROPOSALS

Proposals must be made in strict accordance with the Form of Proposal provided herein, and all blank spaces for bids, alternates and unit prices shall be properly filled in. When requested alternates are not bid, the proposal may be considered incomplete. The bidder agrees that bid on Form of Proposal detached from specifications will be considered and will have the same force and effect as if attached thereto. Photocopied or faxed proposals will not be considered. Numbers shall be stated both in writing and in figures for the base bids and alternates. Any modifications to the Form of Proposal (including alternates and/or unit prices) will disqualify the bid and may cause the bid to be rejected.

The contractor shall fill in the Form of Proposal as follows:

a. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.

b. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co–Partner" appearing after the name of the partner executing them.

c. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.

d. If the proposal is made by a joint venture, it shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable.

e. All signatures shall be properly witnessed.

f. If the contractor's license is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the proposal. The title "Licensee" shall appear under his/her signature.

Proposals shall be addressed as indicated in the Advertisement for Bids and shall be delivered enclosed in an opaque sealed envelope, marked "Proposal" and bearing the title of the work, name of the bidder, and the bidder's license number, if required. Bidders shall clearly mark on the outside of the bid envelope which contract(s) they are bidding.

It shall be the specific responsibility of the bidder to deliver his bid to the proper official at the appointed place and prior to the announced time for the opening of bids. Later delivery of a bid for any reason, including delivery by the United States Postal Service, shall disqualify the bid.

Modifications of previously deposited bids will be acceptable only if delivered in writing or by telegram or fax to the place of the bid opening prior to the time for opening bids. Telegraphic and fax modifications must be confirmed in writing within 72 hours of the opening of bids.

Unit prices quoted in the proposal shall include overhead and profit and shall be the full compensation for the contractor's cost involved in the work. See General Conditions, Article 19c–1.

The Identification of Minority Business Participation and either Affidavit A or Affidavit B shall be

submitted with the proposal, in the same envelope as the proposal.

The proposal shall be accompanied by the Bid Security, in the same envelope as the proposal, and as described elsewhere in the Instructions to Bidders.

2. EXAMINATION OF CONDITIONS

It is understood and mutually agreed that by submitting a bid the contractor acknowledges that he has carefully examined all documents pertaining to the work, the location, accessibility and general character of the site of the work and all existing buildings and structures within and adjacent to the site, and has satisfied himself as to the nature of the work, the condition of existing buildings and structures, the conformation of the ground, the character, quality and quantity of the material to be encountered, the character of the equipment, machinery, plant and any other facilities needed preliminary to and during prosecution of the work, the general and local conditions, the construction hazards, and all other matters, including, but not limited to, the labor situation which can in any way affect the work under the contract, and including all safety measures required by the Occupational Safety and Health Act of 1970 and all rules and regulations issued pursuant thereto. It is further mutually agreed that by submitting a proposal the contractor acknowledges that he has satisfied himself as to the feasibility and meaning of the plans, drawings, specifications and other contract documents for the construction of the work and that he accepts all the terms, conditions and stipulations contained therein; and that he is prepared to work in cooperation with other contractors performing work on the site.

Reference is made to contract documents for the identification of those surveys and investigation reports of subsurface or latent physical conditions at the site or otherwise affecting performance of the work which have been relied upon by the designer in preparing the documents. The owner will make copies of all such surveys and reports available to the bidder upon request.

Each bidder may, at his own expense, make such additional surveys and investigations as he may deem necessary to determine his bid price for the performance of the work. Any on–site investigation shall be done at the convenience of the owner. Any reasonable request for access to the site will be honored by the owner.

3. BULLETINS AND ADDENDA

Any addenda to drawings or specifications issued during the time of bidding are to be considered covered in the proposal and in closing a contract they will become a part thereof. It shall be the contractor's responsibility to ascertain prior to bid time the addenda issued and to see that his bid includes any changes thereby required.

Should the bidder find discrepancies in, or omission from, the drawings or documents or should he be in doubt as to their meaning, he shall at once notify the designer who will send written instructions in the form of addenda to all bidders. Notification should be no later than seven (7) days prior to the date set for receipt of bids. Neither the owner nor the designer will be responsible for any oral instructions.

All addenda shall be acknowledged by the bidder(s) on the Form of Proposal.

4. BID SECURITY

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company insured by the Federal Deposit Insurance Corporation, or a bid bond in an amount equal to not less than five percent (5%) of the proposal, said deposit to be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten (10) days after the award or to give satisfactory surety as required by law.

Bid bond shall be conditioned that the surety will, upon demand, forthwith make payment to the obligee upon said bond if the bidder fails to execute the contract. The owner may retain bid securities of any bidder(s) who may have a reasonable chance of award of contract for the full duration of time stated in the Notice to Bidders.

Other bid securities may be released sooner, at the discretion of the owner. All bid securities (cash or certified checks) shall be returned to the bidders promptly after award of contracts, and no later then seven (7) days after expiration of the holding period stated in the Notice to Bidders. Standard Form of Bid Bond is included in these specifications.

5. RECEIPT OF BIDS

Bids shall be received in strict accordance with requirements of the General Statutes of North Carolina. Bid security shall be required as prescribed by statute. Prior to opening of any bids on the project, any bidder will be permitted to change or withdraw his bid.

6. OPENING OF BIDS

Upon opening, all bids shall be read aloud. Once any bid is opened, there shall not be any withdrawal of bids by any bidder and no bids may be returned by the designer to any bidder. After the bid opening, a bidder may request that his bid be withdrawn from consideration without forfeiture of his bid security in accordance with the provisions of the North Carolina General Statutes. After the opening of bids, no bid may be withdrawn, except under the provisions of General Statutes, for a period of thirty days unless otherwise specified. Should the successful bidder default and fail to execute a contract, the contract may be awarded to the next lowest and responsible bidder. The owner reserves the unqualified right to reject any and all bids. Reasons for rejection may include, but shall not be limited to, the following:

a. If the Form of Proposal furnished to the bidder is not used or is altered.

b. If the bidder fails to insert a price for all bid items, alternate and unit prices requested.

c. If the bidder adds any provisions reserving the right to accept or reject any award.

d. If there are unauthorized additions or conditional bids, or irregularities of any kind which tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.

e. If the bidder fails to complete the proposal form where information is requested so the bid may be properly evaluated by the owner.

f. If the unit prices contained in the bid schedule are unacceptable to the owner.

g. If the bidder fails to comply with other instructions stated herein.

7. BID EVALUATION

The award of the contract will be made to the lowest responsible bidder as soon as practical. The owner may award on the basis of the base bid and any alternates the owner chooses.

Before awarding a contract, the owner may require the apparent low bidder to qualify himself to be a responsible bidder by furnishing any or all of the following data:

a. The latest financial statement showing assets and liabilities of the company or other information satisfactory to the owner.

b. A listing of completed projects of similar size.

c. Permanent name and address of place of business.

d. The number of regular employees of the organization and length of time the organization has been in

business under present name.

e. The name and home office address of the surety proposed and the name and address of the responsible local claim agent.

f. The names of members of the firms who hold appropriate trade licenses, together with license numbers.

Failure or refusal to furnish any of the above information, if requested, shall constitute a basis for disqualification of any bidder.

In determining the lowest responsible bidder, the owner shall take into consideration the past performance of the bidder on construction contracts for the owner with particular concern given to completion times, quality of work, cooperation with other contractors, and cooperation with the designer and owner.

Should the owner adjudge that the apparent low bidder is not the lowest responsible bidder by virtue of the above information, said apparent low bidder will be so notified and his bid security shall be returned to him.

8. PERFORMANCE BOND

The successful bidder, upon award of contract, shall furnish a performance bond in an amount equal to 100 percent of the contract price. See Article 35, General Conditions.

9. PAYMENT BOND

The successful bidder, upon award of contract, shall furnish a payment bond in an amount equal to 100 percent of the contract price. See Article 35, General Conditions.

10. PAYMENTS

Payments to the successful bidders (contractors) will be made on the basis of monthly estimates. See Article 31, General Conditions.

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ARTICLE 1 – DEFINITIONS

a. The contract documents; consist of the Notice to Bidders; Instructions to Bidders; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the proposal; the contract; the performance bond; the payment bond; insurance certificates. All of these items together form the contract.

b. The owner; is the agency named in the contract.

c. The designer(s); are those referred to within this contract, or their authorized representatives. The designer(s), as referred to herein, shall mean architect and/or engineer. They will be referred to hereinafter as if each were of the singular number, masculine gender.

d. The contractor;, as referred to hereinafter, shall be deemed to be either of the several contracting parties called the "Party of the First Part" in either of the several contracts in connection with the total project. Where, in special instances hereinafter, a particular contractor is intended, an adjective precedes the word "contractor," as "general," "heating," etc.

e. A subcontractor; as the term is used herein, shall be understood to be one who has entered into a direct contract with a contractor, and includes one who furnishes materials worked to a special design in accordance with plans and specifications covered by the contract, but does not include one who only sells or furnishes materials not requiring work so described or detailed.

f. Written notice; shall be defined as notice in writing delivered in person to the contractor, or to a partner of the firm in the case of a partnership, or to a member of the contracting organization, or to an officer of the organization in the case of a corporation, or sent to the last known business address of the contracting organization by registered mail.

g. Work, as used herein as a noun, is intended to include materials, labor and workmanship of the appropriate contractor.

h. The project; is the total construction work to be performed under the contract documents by the several contractors.

i. Project expediter, as used herein, shall be that contractor so designated in the contract documents. The project expediter shall have the following responsibilities:

1. Schedule the work of all contractors.

2. Maintain a project progress schedule for all contractors.

3. Give adequate notice to all contractors to ensure efficient continuity of all phases of the work.

4. Notify the designer of any changes in the project schedule.

j. Change order, as used herein, shall mean a written order to the contractor subsequent to the signing of the contract authorizing a change in the contract. The change order shall be signed by the contractor, designer and the owner, in that order (Article 19).

k. Time of completion, as stated in the contract documents, is to be interpreted as consecutive calendar days measured from the date established in the written Notice to Proceed, or such other date as may be established herein (Article 23).

l. Liquidated damages, as stated in the contract documents, is an amount reasonably estimated in advance to cover the losses incurred by the owner by reason of failure of the contractor(s) to complete the work within the time specified.

m. Surety;, as used herein, shall mean the bonding company or corporate body which is bound with and for the contractor, and which engages to be responsible for the contractor and his acceptable performance of the work.

ARTICLE 2 – INTENT AND EXECUTION OF DOCUMENTS;

a. The drawings and specifications are complementary, one to the other. That which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.

b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.

c. The contractor shall execute each copy of the proposal, contract, performance bond and payment bond as follows:

1. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.

2. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co–Partner" appearing after the name of the partner executing them.

3. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.

4. If the documents are made by a joint venture, they shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable to each particular member.

5. All signatures shall be properly witnessed.

6. If the contractor's license is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the contract. The title "Licensee" shall appear under his/her signature.

7. The bonds shall be executed by an attorney–in–fact. There shall be attached to each copy of the bond a certified copy of power of attorney properly executed and dated.

8. Each copy of the bonds shall be countersigned by an authorized individual agent of the bonding company licensed to do business in North Carolina. The title "Licensed Resident Agent" shall appear after the signature.

9. The seal of the bonding company shall be impressed on each signature page of the bonds.

10. The contractor's signature on the performance bond and the payment bond shall correspond with that on the contract.

ARTICLE 3 – CLARIFICATIONS AND DETAIL DRAWINGS;

a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer with reasonable promptness by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.

b. The contractor(s) and the designer shall prepare, if deemed necessary, a schedule fixing dates upon which foreseeable clarifications will be required. The schedule will be subject to addition or change in accordance with progress of the work. The designer shall furnish drawings or clarifications in accordance with that schedule. The contractor shall not proceed with the work without such detail drawings and/or written clarifications.

ARTICLE 4 – COPIES OF DRAWINGS AND SPECIFICATIONS;

The designer shall furnish free of charge to the contractors copies of plans and specifications as follows:

a. General contractor – Up to twelve (12) sets of general contractor drawings and specifications, up to six (6) sets to include drawings and specifications of all other contracts.

b. Each other contractor – Up to six (6) sets of the appropriate drawings and specifications, up to three (3) sets to include drawings and specifications of all other contracts.

c. Additional sets shall be furnished at cost, including mailing, to the contractor upon request by the contractor. This cost shall be stated in the bidding documents.

d. For the purposes of a single-prime contract, the contractor shall receive up to 30 sets of drawings and specifications.

ARTICLE 5 – SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA;

a. The contractor shall submit to the designer all shop or setting drawings, descriptive data, samples, color charts, etc., required for the work. All shop drawings shall be reviewed by the contractor and shall bear the contractor's stamp of approval before being forwarded to the designer. Shop drawings shall be submitted in triplicate in time to avoid delay of the work or any part thereof. The designer shall review the shop drawings promptly, noting desired corrections, if any, and shall return two copies to the contractor within twenty (20) calendar days after receipt from the contractor. The contractor shall furnish corrected drawings in triplicate to the designer. Two copies of approved drawings shall be returned to the contractor.

b. Approval of shop drawings by the designer shall not be construed as relieving the contractor from responsibility for compliance with the design or terms of the contract documents nor from responsibility for errors of any sort in the shop drawings, unless such lack of compliance or errors first have been called in writing to the attention of the designer by the contractor.

ARTICLE 6 – WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE;

a. The contractor shall maintain, in readable condition at his job office, one complete set of working drawings and specifications for his work including all shop drawings. Such drawings and specifications shall be available for use by the designer or his authorized representative.

b. The contractor shall maintain at the job office, a day–to–day record of work–in–place that is at variance

with the contract documents. Such record is to be provided in full to the designer upon completion and acceptance of the project.

ARTICLE 7 – OWNERSHIP OF DRAWINGS AND SPECIFICATIONS;

All drawings and specifications are instruments of service and remain the property of the Owner. The use of these instruments on work other than this contract without permission of the owner is prohibited. All copies of drawings and specifications other than contract copies shall be returned to the owner upon request after completion of the work.

ARTICLE 8 – MATERIALS, EQUIPMENT, EMPLOYEES;

a. The contractor shall, unless otherwise specified, supply and pay for all labor, transportation, materials, tools, apparatus, lights, power, heat, sanitary facilities, water, scaffolding and incidentals necessary for the completion of his work, and shall install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same, and shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied therefrom, all in accordance with the contract documents.

b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.

c. Upon notice, the contractor shall furnish evidence as to quality of materials.

d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the Contractor has the option of using any product and manufacturer combination listed. However, the contractor shall be aware that the cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable. Substitution of materials, items or equipment of equal or equivalent design shall be submitted to the architect or engineer for approval or disapproval; such approval or disapproval shall be made by the architect or engineer prior to the opening of bids.

e. Each contractor shall obtain written approval from the designer for the use of substitute products, materials or equipment claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered. Applications for approvals shall be made by the contractor and not by subcontractors or material suppliers. The contractor shall submit within twenty (20) days following award of contract a complete list of materials proposed for the job. When this list is approved, no further substitutions will be permitted except in unusual or extenuating circumstances. If no list is submitted, the contractor shall supply materials specified.

f. The designer is the judge of equality for proposed substitution of products, materials or equipment.

g. If at any time during the construction and completion of the work covered by these contract documents, the conduct of any workman of the various crafts be adjudged a nuisance to the owner or designer, or if any workman be considered detrimental to the work, the contractor shall order such parties removed immediately from grounds.

ARTICLE 9 – ROYALTIES, LICENSES AND PATENTS;

It is the intention of the contract documents that the work covered herein will not constitute in any way infringement of any patent whatsoever unless the fact of such patent is clearly evidenced herein. The contractor shall protect and save harmless the owner against suit on account of alleged or actual infringement. The contractor shall pay all royalties and/or license fees required on account of patented articles or processes, whether the patent rights are evidenced hereinafter.

ARTICLE 10 – PERMITS, INSPECTIONS, FEES, REGULATIONS;

a. The contractor shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. If the contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the designer in writing. See Instructions to Bidders, Paragraph 3, Bulletins and Addenda. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without such notice to the designer, he shall bear all cost arising therefrom. Additional requirements implemented after bidding will be subject to equitable negotiations.

b. All work under this contract shall conform to the North Carolina State Building Code and other state, local and national codes as are applicable. The cost of all required inspections and permits shall be the responsibility of the contractor.

c. Project is subject to county and municipal building codes and inspection by local authorities. These permits and inspections shall be paid by the contractor.

ARTICLE 11 – PROTECTION OF WORK, PROPERTY AND THE PUBLIC;

a. The contractors shall be jointly responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the owner or designer, and by laws or ordinances governing such conditions. They shall be responsible for any damage to the owner's property, or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. They shall be responsible for and pay for any claims against the owner. All contractors shall have access to the project at all times.

b. The contractor shall provide cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building, whether set by him, or any of the subcontractors. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the owner.

c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the designer.

d. The contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations by building substantial boxes around same. He shall barricade all walks, roads, etc., as directed by the designer to keep the public away from the construction. All trenches, excavations or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.

e. The contractor shall provide all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. Accident Prevention Manual in Construction, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. He shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. He shall protect against damage or injury resulting from falling materials and he shall maintain all protective devices and signs throughout the progress of the work.

f. 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), and revisions thereto as adopted by General Statutes of North Carolina 95–126 through 155.

g. The contractor shall designate a responsible member of his organization as safety inspector, whose duties shall include accident prevention on the work project. The name of the safety inspector shall be made known to the designer at the time the work is started.

h. In the event of emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the contractor is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage. Any compensation claimed by the contractor on account of such action shall be determined as provided for under Article 19(c).

ARTICLE 12 – SEDIMENTATION POLLUTION CONTROL ACT OF 1973;

a. Any land–disturbing activity performed by the contractor(s) in connection with the project shall comply with all erosion control measures set forth in the contract documents and any additional measures which may be required in order to ensure that the project is in full compliance with the Sedimentation Pollution Control Act of 1973, as implemented by Title 15, North Carolina Administrative Code, Chapter 4, Sedimentation Control, Subchapters 4A, 4B and 4C, as amended (15 N.C.A.C. 4A, 4B and 4C).

b. Upon receipt of notice that a land–disturbing activity is in violation of said act, the contractor(s) shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.

c. The contractor(s) shall be responsible for defending any legal actions instituted pursuant to N.C.G.S. 113A-64 against any party or persons described in this article.

d. To the fullest extent permitted by law, the contractor(s) shall indemnify and hold harmless the owner, the designer and the agents, consultants and employees of the owner and designer, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 – INSPECTION OF THE WORK;

a. It is a condition of this contract that the work shall be subject to inspection during normal working hours by the designer, designated official representatives of the owner, and those persons required by state law to test special work for official approval. The contractor shall therefore provide safe access to the work at all times for such inspections.

b. All instructions to the contractor will be made only by or through the designer or his designated project representative. Observations made by official representatives of the owner shall be conveyed to the designer for review and coordination prior to issuance to the contractor.

c. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the contractor shall give adequate notice to the designer of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the designer. Such special tests or inspections will be made in the presence of the designer, or his authorized representative, and it shall be the contractor's responsibility to serve ample notice of such tests.

d. All laboratory tests shall be paid by the owner unless provided otherwise in the contract documents except the general contractor shall pay for laboratory tests to establish design mix for concrete, and for additional tests to prove compliance with contract documents where materials have tested deficient except when the testing laboratory did not follow the appropriate ASTM testing procedures.

e. Should any work be covered up or concealed prior to inspection and approval by the designer, such work shall be uncovered or exposed for inspection, if so requested by the designer in writing. Inspection of the work will be made promptly upon notice from the contractor. All cost involved in uncovering, repairing, replacing, recovering and restoring to design condition, the work that has been covered or concealed will be paid by the contractor involved.

f. If any other portion of the work has been covered which the designer has not specifically requested to observe prior to being covered, the designer may request to see such work and it shall be uncovered by the contractor. If such work be found in accordance with the contract documents, the cost of uncovering and replacement shall, by appropriate change order, be charged to the owner. If such work be found not in accordance with the contract documents, the contractor shall pay such costs unless it be found that this condition was caused by the owner or a separate contractor as provided in Article 15, in which event the owner or the separate contractor shall be responsible for the payment of such costs.

ARTICLE 14 – CONSTRUCTION SUPERVISION;

a. Throughout the progress of the work, each contractor shall keep on the job a competent superintendent or supervisory staff satisfactory to the designer. The superintendent shall not be changed without the consent of the designer unless said superintendent ceases to be employed by the contractor or ceases to be competent. The superintendent shall have authority to act on behalf of the contractor, and instructions, directions or notices given to him shall be as binding as if given to the contractor. However, important directions, instructions and notices will be confirmed in writing to the contractor as will all such items if requested by the contractor.

b. The contractor shall examine and study the drawings and specifications and fully understand the project design, and shall provide constant and efficient supervision to the work. Should he discover any discrepancies of any sort in the drawings or specifications, he shall report them to the designer without delay. He will not be held responsible for discrepancies in the drawings and/or specifications, but shall be held responsible to report them should they become known to him.

c. All contractors shall be required to cooperate and consult with each other during the construction of this project. Each contractor shall lay out and execute his work so as to cause the least delay to other contractors. Each contractor shall be responsible for any damage to other contractor's work, and each contractor shall be financially responsible to the another contractors for undue delay caused by him to other contractors on the project.

d. The contractor is required to attend monthly job site progress conferences as called by the designer. The contractor shall be represented at these job progress conferences by both home office and project personnel. These representatives shall have authority to act on behalf of the contractor. These meetings shall be open to subcontractors, material suppliers and any others who can contribute toward maintaining required job progress. It shall be the principal purpose of these meetings, or conferences, to effect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. Each contractor shall be prepared to assess progress of the work as required in his particular contract and to recommend remedial measures for correction of progress as may be appropriate. The designer or his authorized representative shall be the coordinator of the conferences and shall preside as chairman.

e. The contractor(s) shall, if required by the Supplementary General Conditions, employ a registered engineer or registered land surveyor to lay out the work and to establish a bench mark nearby in a location where same will not be disturbed and where direct instruments sights may be taken.

f. The designer shall designate a project expediter on projects involving two or more prime contracts. The project expediter shall be designated in the Supplementary General Conditions.

g. It shall be the responsibility of the project expediter to cooperate with and obtain from the several contractors on the job their respective schedules and to integrate them into a project progress schedule that will show graphically, by a detailed bar chart, CPM or other acceptable and approved methods, the projected progress of the job from start to finish and within the allotted time frame. All contractors shall review the proposed progress schedule and approve same in writing to the designer and the project expediter.

h. The progress schedule shall be presented to the designer no later than thirty (30) days after written notice to proceed. No application for payment will be processed until this schedule is received.

i. The schedule will be distributed to all contractors and displayed at the job site.

j. The several contractors shall be responsible for their schedule and must notify the project expediter of any changes or adjustments to their schedule. The project expediter shall maintain the progress schedule, making monthly adjustments, updates, corrections, etc., that are necessary, keeping all contractors and the designer fully informed. Failure to provide an updated schedule may be grounds for withholding reduction of retainage as set forth in Article 31.

k. The project expediter shall notify each contractor of such events or time frames that are critical to the progress of the job. Such notice shall be timely and reasonable. Should the progress be delayed due to the work of any of the several contractors, it shall be the duty of the project expediter to immediately notify the contractor(s) responsible for such delay, the designer, the State Construction Office and other prime contractors. The designer shall notify the bonding company that the progress is not being maintained and shall make a recommendation to the owner regarding further action.

l. Designation as project expediter entails an additional project control responsibility and does not alter in any way the responsibility of the contractor so designated, nor the responsibility of the other contractors involved in the project.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS;

a. Chapter 143, Article 8, General Statutes of North Carolina, requires separate contracts to be awarded for the general construction, heating and ventilating and air conditioning, plumbing, and electrical installations. The owner reserves the right to prepare separate specifications, receive separate bids, and award separate contracts for such other major items of work as may be in the best interest of the owner. Chapter 143, Article 8, was amended June 28, 1989, to allow public contracts to be bid in the alternative as multi-prime or single-prime contracts.

b. All contractors shall cooperate with each other in the execution of their work, and shall plan their work in such manner as to avoid conflicting schedules or delay of the work. See Article 14, Construction Supervision.

c. If any part of contractor's work depends upon the work of another contractor, defects which may affect that work shall be reported to the designer in order that prompt inspection may be made and the defects corrected. Commencement of work by a contractor where such condition exists will constitute acceptance of the other contractor's work as being satisfactory in all respects to receive the work commenced, except as to defects which may later develop. The designer shall be the judge as to the quality of work and shall settle all disputes on the matter between contractors.

d. Any mechanical or electrical work such as sleeves, inserts, chases, etc., which is located in the work of the general contractor shall be built in by the general contractor. The respective mechanical and electrical contractors shall set all sleeves, inserts and other devices built into the structure in cooperation and under the supervision of the

general contractor. The responsibility for the exact location of such items shall be that of the mechanical and/or electrical contractor.

e. Should a contractor cause damage to the work or property of another contractor, he shall be directly responsible, and upon notice, shall promptly settle the claim or otherwise resolve the dispute.

ARTICLE 16 – SUBCONTRACTS AND SUBCONTRACTORS;

a. Within fourteen (14) days after award of the contract, the contractor shall submit to the designer a list giving the names and addresses of subcontractors and equipment and material suppliers he proposes to use, together with the scope of their respective parts of the work. Should any subcontractor be disapproved by the designer, the designer shall submit his reasons for disapproval in writing to the owner for its consideration with a copy to the contractor. If the owner concurs with the designer's recommendation, the contractor shall submit a substitute for approval. The designer shall act promptly in the approval of subcontractors, and when approval of the list is given, no changes of subcontractors will be permitted except for cause or reason considered justifiable by the designer.

b. The designer will furnish to any subcontractor, upon request, evidence regarding amounts of money paid to the contractor on account of the subcontractor's work.

c. The contractor is and remains fully responsible for his own acts or omissions as well as those of any subcontractor or of any employee of either. The contractor agrees that no contractual relationship exists between the subcontractor and the owner in regard to the contract, and that the subcontractor acts on this work as an agent or employee of the contractor.

d. The owner reserves the right to limit the amount of portions of work to be subcontracted as hereinafter specified.

ARTICLE 17 – CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS;

The contractor agrees that the terms of these contract documents shall apply equally to each subcontractor as to the contractor, and the contractor agrees to take such action as may be necessary to bind each subcontractor to these terms. The contractor further agrees to conform to the Code of Ethical Conduct as adopted by the Associated General Contractors of America, Inc., with respect to contractor-subcontractor relationships, and that payments to subcontractors shall be made in accordance with the provisions of G.S. 143-134.1 titled Interest on final payments due to prime contractors: payments to subcontractors.

a. On all public construction contracts which are let by a board or governing body of the state government or any political subdivision thereof, except contracts let by the Department of Transportation pursuant to G.S. 136–28.1, the balance due prime contractors shall be paid in full within 45 days after respective prime contracts of the project have been accepted by the owner, certified by the architect, engineer or designer to be completed in accordance with terms of the plans and specifications, or occupied by the owner and used for the purpose for which the project was constructed, whichever occurs first. Provided, however, that whenever the architect or consulting engineer in charge of the project determines that delay in completion of the project in accordance with terms of the plans and specifications is the fault of the contractor, the project may be occupied and used for the purposes for which it was constructed without payment of any interest on amounts withheld past the 45 day limit. No payment shall be delayed because of the failure of another prime contractor on such project to complete his contract. Should final payment to any prime contractor beyond the date such contracts have been certified to be completed by the designer or architect, accepted by the owner, or occupied by the owner and used for the purposes for which the project was constructed, be delayed by more than 45 days, said prime contractor shall be paid interest, beginning on the 46th day, at the rate of one percent (1%) per month or fraction thereof unless a lower rate is agreed upon on such unpaid balance as may be due. In addition to the above final payment provisions, periodic payments due a prime contractor during construction shall be paid in accordance with the payment provisions of the contract documents or said prime contractor shall be paid interest on any such unpaid amount at the rate stipulated above for delayed final

payments. Such interest shall begin on the date the payment is due and continue until the date on which payment is made. Such due date may be established by the terms of the contract. Where a conditional acceptance of a contract exists, and where the owner is retaining a reasonable sum pending correction of such conditions, interest on such reasonable sum shall not apply.

b. Within seven days of receipt by the prime contractor of each periodic or final payment, the prime contractor shall pay the subcontractor based on work completed or service provided under the subcontract. Should any periodic or final payment to the subcontractor be delayed by more than seven days after receipt of periodic or final payment by the prime contractor, the prime contractor shall pay the subcontractor interest, beginning on the eighth day, at the rate of one percent (1%) per month or fraction thereof on such unpaid balance as may be due.

c. The percentage of retainage on payments made by the prime contractor to the subcontractor shall not exceed the percentage of retainage on payments made by the owner to the prime contractor. Any percentage of retainage on payments made by the prime contractor to the subcontractor that exceeds the percentage of retainage on payments made by the owner to the prime contractor shall be subject to interest to be paid by the prime contractor to the subcontractor at the rate of one percent (1%) per month or fraction thereof.

d. Nothing in this section shall prevent the prime contractor at the time of application and certification to the owner from withholding application and certification to the owner for payment to the subcontractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of subcontractor to make timely payments for labor, equipment and materials; damage to prime contractor or another subcontractor; reasonable evidence that subcontract cannot be completed for the unpaid balance of the subcontract sum; or a reasonable amount for retainage not to exceed the initial percentage retained by owner.

ARTICLE 18 – DESIGNER'S STATUS;

a. The designer shall provide general administration of the performance of construction contracts, including liaison and necessary inspection of the work to ensure compliance with plans and specifications. He is the agent of the owner only for the purpose of constructing this work and to the extent stipulated in the contract documents. He has authority to stop work or to order work removed, or to order corrections of faulty work where such action may be necessary to assure successful completion of the work.

b. The designer is the impartial interpreter of the contract documents, and, as such, he shall exercise his powers under the contract to enforce faithful performance by both the owner and the contractor, taking sides with neither.

c. Should the designer cease to be employed on the work for any reason whatsoever, then the owner shall employ a competent replacement who shall assume the status of the former designer.

d. The designer will make periodic inspections of the project at intervals appropriate to the stage of construction. He will inspect the progress, the quality and the quantity of the work.

e. The designer and the owner shall have access to the work whenever it is in preparation and progress during normal working hours. The contractor shall provide facilities for such access so the designer may perform his functions under the contract documents.

f. Based on the designer's inspections and evaluations of the project, the designer shall issue interpretations, directives and decisions as may be necessary to administer the project. His decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract.

ARTICLE 19 – CHANGES IN THE WORK;

a. The owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the contractor from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.

b. Except in an emergency endangering life or property, NO CHANGE SHALL BE MADE BY THE CONTRACTOR EXCEPT UPON WRITTEN ORDER FROM THE DESIGNER, COUNTERSIGNED BY THE OWNER AUTHORIZING SUCH CHANGE. AND NO CLAIM FOR ADJUSTMENTS OF THE CONTRACT PRICE SHALL BE VALID UNLESS THIS PROCEDURE IS FOLLOWED.

c. In determining the values of changes, either additive or deductive, contractors are restricted to the use of the following methods:

1. Where the extra work involved is covered by unit prices quoted in the proposal, the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed of the items involved.

2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.

d. In the event of emergency endangering life or property, the contractor may be directed to proceed on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as may be required, a correct account of costs together with all proper invoices, payrolls and supporting data. Upon completion of the work the change order will be prepared as outlined under either Method "c(1)" or Method "c(2)" or both.

e. Under Methods "c(2)" and Paragraph "d" above, the allowances for overhead and profit combined shall not exceed twenty percent (20%) of net cost except where the change involves a subcontractor, allowance shall not exceed fifteen percent (15%) for the subcontractor, and ten percent (10%) for the prime contractor. Under Method "c(1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph "d" above, the contractor shall include no less than ten percent (10%) profit, but no allowances for overhead.

f. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein may include all items of material and labor, rental value of power tools and equipment, bond adjustments and sales tax. The allowance for labor burden which includes such items of cost as workmen's compensation insurance, unemployment insurance, special insurance, Social Security and old age benefit, and fringe benefits shall be actual costs not to exceed thirty-five percent (35%) of total labor cost. Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the owner.

g. The following items shall be considered as overhead: insurance other than mentioned above, supervision, superintendents, timekeepers, clerks, expediters, watchmen, small tools, incidental job burdens and general office expense, and all other items not included in "cost" as above defined.

h. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods.

ALL CHANGE ORDERS SHALL BE SUPPORTED BY A BREAKDOWN SHOWING METHOD OF ARRIVING AT NET COST AS DEFINED ABOVE.

I. In all change orders, normal procedure will be for the designer to obtain quotations and supporting data,

and verify correctness. The designer shall prepare the change order, secure the contractor's signature, certify the change order by his signature, and forward the change order and all supporting data to the owner for the owner's signature. Upon approval by the Owner, one copy remains with the Owner, and the remaining copies are sent to the designer for distribution to the contractor(s) and the surety. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.

j. At the time of signing a change order, the contractor shall be required to certify as follows:

"I certify that my bonding company will be notified forthwith that my contract has been changed by the amount of this change order, and that a copy of the approved change order will be mailed upon receipt by me to my surety."

k. A change order, when issued, shall be full compensation, or credit, for the extra work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.

l. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner without prejudice, may perform or have performed that portion of the work requested in the change order.

ARTICLE 20 – CLAIMS FOR EXTRA COST;

a. Should the contractor consider that as a result of any instructions given in any form by the designer, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the designer within seven (7) days without delay, and shall not proceed with the work affected until further advised, except in emergency involving the safety of life or property, which condition is covered in Article 19(d) and Article 11(h). No claims for extra compensation will be considered unless the claim is so made. The designer shall render a written decision within seven (7) days of receipt of claim.

b. THE CONTRACTOR SHALL NOT ACT ON INSTRUCTIONS RECEIVED BY HIM FROM PERSONS OTHER THAN THE DESIGNER, AND ANY CLAIMS FOR EXTRA COMPENSATION OR EXTENSION OF TIME ON ACCOUNT OF SUCH INSTRUCTION WILL NOT BE HONORED. The designer will not be responsible for misunderstandings claimed by the contractor of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.

c. **Resolution of Claims and Disputes**

The Designer will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Designer expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Designer may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

If a Claim has been resolved, the Designer will prepare or obtain appropriate documentation.

If a Claim has not been resolved, the party marking the Claim shall, within ten days after the Designer=s preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Designer, (2) modify the initial Claim or (3) notify the Designer that the initial Claim stands.

If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Designer, the Designer will notify the parties in writing that the Designer=s decision will br

made within seven days, which decision shall be final and binding on the parties but subject to arbitration. Upon expiration of such period, the Designer will render to the parties the Designer=s written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Contractor=s default, the Designer may, but is not obligated to, notify the surety and request the surety=s assistance in resolving the controversy.

d. **Arbitration**

1. Controversies and Claims Subject to Arbitration. Any controversy or Claim arising out of or related to the Contract, or the breach thereof, shall be settled by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association, and judgement upon the award rendered by the arbitrator or arbitrators may be entered in any court having jurisdiction thereof. Such controversies or Claims upon which the Designer has given notice and rendered a decision as provided in Subparagraph C.4 shall be subject to arbitration upon written demand of either party. Arbitration may be commenced when 45 days have passed after a Claim has been referred to the Designer and no decision has been rendered.

2. Rules and Notices for Arbitration. Claims between the Owner and Contractor not resolved under Paragraph C.4 shall, if subject to arbitration under Subparagraph D.1, be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect, unless the parties mutually agree otherwise. Notice of demand for arbitration shall be filed in writing with the other party to the Agreement between the Owner and Contractor and with the American Arbitration Association, and a copy shall be filed with the Designer.

3. Contract Performance During Arbitration. During arbitration proceedings, the Owner and Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

4. When Arbitration May Be Demanded. Demand for arbitration of any Claim may not be made until the earlier of (1) the date on which the Designer has rendered a final written decision on the Claim, (2) the tenth day after the parties have presented evidence to the Designer or have been given reasonable opportunity to do so, if the Designer has not rendered a final written decision by the date.

4.1 When a written decision of the Designer states that (1) the decision is final but subject to arbitration and (2) a demand for arbitration of a Claim covered by such decision must be made within 30 days after the date on which the party making the demand receives the final written decision, then failure to demand arbitration within said 30 days= period shall result in the Designer=s decision becoming final and binding upon the Owner and Contractor. If the Designer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence, but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.

4.2 A demand for arbitration shall be made within the time limits specified above as applicable, and in other cases within a reasonable time after the Claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations.

5. **Limitation on Consolidation or Joinder.** No arbitration arising out of or relating to the Contract documents shall include, by consolidation or joinder or in any other manner, the Designer, the Designer=s employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Designer, Owner, CONTRACTOR and any other person or entity sought to be jointed. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner,

CONTRACTOR, a separate contractor and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, CONTRACTOR or a separate contractor shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a dispute not described therein or with a person or entity not named or described therein. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

6. **Claims and Timely Assertion of Claims.** A party who files a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded. When a party fails to include a Claim through oversight, inadvertence or excusable neglect, or when a Claim has matured or been acquired subsequently, the arbitrator or arbitrators may permit amendment.

7. **Judgment on Final Award.** The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

ARTICLE 21 – MINOR CHANGES IN THE WORK;

The designer will have the authority to order minor changes in the work not involving an adjustment in the contract sum or time for completion, and not inconsistent with the intent of the contract documents. Such changes shall be effected by written order, and shall be binding on the owner and the contractor.

ARTICLE 22 – UNCORRECTED FAULTY WORK;

Should the correction of faulty or damaged work be considered inadvisable or inexpedient by the owner and the designer, the owner shall be reimbursed by the contractor. A change order will be issued to reflect a reduction in the contract sum.

ARTICLE 23 – TIME OF COMPLETION, DELAYS, EXTENSION OF TIME;

a. The time to be allowed for construction is stated in the Supplementary General Conditions and in the Form of Proposal. The project expediter, Article 1(I) and Article 14, upon notice of award of contract, shall confer with other contractors, prepare a construction schedule based on the allowed time, and submit such a schedule to the other contractors for approval and coordination with a copy to the designer for comment. When the schedule has been approved by all contractors, the project expediter shall distribute copies to all contractors, the designer and the owner. All contractors shall maintain progress in accordance with the schedule and with terms of the construction contract. The progress schedule shall be revised as required by the project expediter in cooperation with other contractors and the designer. See Article 14.

b. The contractors shall commence work to be performed under this agreement on a date to be specified in a written order from the designer and shall fully complete all work hereunder within the number of consecutive calendar days stated. For each day in excess of the above number of days, the contractor(s) shall pay the owner the sum stated as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the owner by reason of failure of said contractor(s) to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.

c. The designer shall be the judge as to the division of responsibility between the contractor(s), based on the construction schedule, weekly reports and job records, and shall apportion the amount of liquidated damages to be paid by each of them, according to delay caused by any or all of them.

d. If the contractor is delayed at any time in the progress of his work by any act or negligence of the owner or the designer, or by any employee of either; by any separate contractor employed by the owner; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the designer and owner determine may justify the delay, then the contract time may be extended by change order for the time which the designer and owner may determine is reasonable.

Time extensions will not be granted for rain, wind, snow or other natural phenomena of normal intensity for the locality where work is performed. For purpose of determining extent of delay attributable to unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where work is performed and on daily weather logs kept on the job site by the contractor reflecting the effect of the weather on progress of the work and initialed by the designer's representative. Time extensions for weather delays do not entitle the contractor to "extended overhead" recovery.

e. Request for extension of time shall be made in writing within twenty (20) days following cause of delay. In case of continuing cause for delay, only one claim is necessary.

f. The contractor shall notify his surety in writing of extension of time granted.

g. No claim shall be allowed on account of failure of the designer to furnish drawings or instructions until two (2) weeks after demand for such drawings and/or instructions. See Article 3.

ARTICLE 24 – PARTIAL UTILIZATION: BENEFICIAL OCCUPANCY;

a. The owner may desire to occupy all or a portion of the project when the work is substantially complete.

b. Prior to the final payment, the owner may request the contractor(s) in writing, through the designer if applicable, to permit him to use a specified part of the project which he believes he may use without significant interference with construction of the other parts of the project. If the contractor(s) agree, the designer will schedule a beneficial occupancy inspection, after which the designer may issue a certificate of substantial completion. The certificate shall include the following documentation:

1. Date of substantial completion.

2. A tentative list of items to be completed or corrected before final payment.

3. Establishing responsibility between contractor and owner for maintenance, heat, utilities and insurance.

4. Establishing the date for guarantees and warranties under terms of the contract.

5. Consent of surety.

6. Endorsement from insurance company permitting occupancy.

c. The owner shall have the right to exclude the contractor from any part of the project which the designer has so certified to be substantially complete, but the owner will allow the contractor reasonable access to complete or correct work to bring it into compliance with the contract.

d. Occupancy by the owner under this article will in no way relieve the contractor from his contractual requirement to complete the project within the specified time. The contractor will not be relieved of liquidated

damages because of beneficial occupancy. The designer may prorate liquidated damages based on the percentage of project occupied.

ARTICLE 25 – FINAL INSPECTION AND ACCEPTANCE;

a. The designer shall determine when the work is completed and ready for final inspection and shall schedule a final inspection at a time and date acceptable to the owner and contractor(s).

b. When contractors finish their work prior to completion by other contractors, these contracts shall be closed out through the final inspection, acceptance and final payment process on recommendation of the designer.

c. At the final inspection, the designer shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the final inspection, the designer shall make the following determinations:

1. That the project is completed and accepted.

2. That the project is accepted subject to the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of acceptance or the owner may invoke Article 28, Owner's Right to Do Work.

3. That the project is not complete and another date for a final inspection will be established.

d. The date of acceptance will establish the following:

1. The beginning of guarantees and warranties period.

2. The date on which the contractor's insurance coverage for public liability, property damage and builder's risk may be terminated.

3. That no liquidated damages (if applicable) shall be assessed after this date.

4. The termination date of utility cost to the contractor.

ARTICLE 26 – CORRECTION OF WORK BEFORE FINAL PAYMENT;

a. Any work, materials, fabricated items or other parts of the work which have been condemned or declared not in accordance with the contract by the designer shall be promptly removed from the work site by the contractor, and shall be immediately replaced by new work in accordance with the contract at no additional cost to the owner. Work or property of other contractors or the owner, damaged or destroyed by virtue of such faulty work, shall be made good at the expense of the contractor whose work is faulty.

b. Correction of condemned work described above shall commence within twenty–four (24) hours after receipt of notice from the designer, and shall make satisfactory progress until completed.

c. Should the contractor fail to proceed with the required corrections, then the owner may complete the work in accordance with the provisions of Article 28.

ARTICLE 27 – CORRECTION OF WORK AFTER FINAL PAYMENT;

See Article 35, Performance Bond and Payment Bond, and Article 42, Guarantee. Neither the final certificate, final payment, occupancy of the premises by the owner, nor any provision of the contract, nor any other act or instrument of the owner, nor the designer, shall relieve the contractor from responsibility for negligence, or faulty material or

workmanship, or failure to comply with the drawings and specifications. He shall correct or make good any defects due thereto and repair any damage resulting therefrom which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The owner will report any defects as they may appear to the contractor and establish a time limit for completion of corrections by the contractor. The owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 – OWNER'S RIGHT TO DO WORK;

If, during the progress of the work or during the period of guarantee, the contractor fails to prosecute the work properly or to perform any provision of the contract, the owner, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the contractor from the designer, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the contractor, such action and cost of same having been first approved by the designer. Should the cost of such action of the owner exceed the amount due or to become due the contractor, then the contractor or his surety, or both, shall be liable for and shall pay to the owner the amount of said excess.

ARTICLE 29 – ANNULMENT OF CONTRACT;

If the contractor fails to begin the work under the contract within the time specified, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the contractor shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the owner may give notice in writing, sent by certified mail, return receipt requested, to the contractor and his surety of such delay, neglect or default, specifying the same, and if the contractor within a period of fifteen (15) days after such notice shall not proceed in accordance therewith, then the owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within fifteen (15) days after being so notified and notify the owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said contractor, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the owner, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said contractor and surety. In case the expense so incurred by the owner shall be less than the sum which would have been payable under the contract, if it had been completed by said contractor, then the said contractor and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the contractor and the surety shall be liable and shall pay to the owner the amount of said excess.

ARTICLE 30 – CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT;

a. Should the work be stopped by order of a court having jurisdiction, or by order of any other public authority for a period of three months, due to cause beyond the fault or control of the contractor, or if the owner should fail or refuse to make payment on account of a certificate issued by the designer within thirty (30) days after receipt of same, then the contractor, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the owner and the designer, may suspend operations on the work or terminate the contract.

b. The owner shall be liable to the contractor for the cost of all materials delivered and work performed on this contract plus 20 percent overhead and profit and shall make such payment. The designer shall be the judge as to the correctness of such payment.

ARTICLE 31 – REQUEST FOR PAYMENT;

a. Not later than the fifth day of the month, the contractor shall submit to the designer a request for payment for work done during the previous month. The request shall be in the form agreed upon between the contractor and the designer, but shall show substantially the value of work done and materials delivered to the site during the period since the last payment, and shall sum up the financial status of the contract with the following information:

1. Total of contract including change orders.

2. Value of work completed to date.

3. Less five percent (5%) retainage, provided however, that after fifty percent (50%) of the work has been satisfactorily completed on schedule, with approval of the owner and written consent of the surety, further requirements for retainage may be waived only so long as work continues to be completed satisfactorily and on schedule.

4. Less previous payments.

5. Current amount due.

b. The contractor, upon request of the designer, shall substantiate the request with invoices of vouchers or payrolls or other evidence.

c. Prior to submitting the first request, the contractor shall prepare for the designer a schedule showing a breakdown of the contract price into values of the various parts of the work, so arranged as to facilitate payments to subcontractors in accordance with Article 17, Contractor and Subcontractor Relationships.

d. When payment is made on account of stored materials and equipment, such materials must be stored on the owner's property, and the requests for payments shall be accompanied by invoices or bills of sale or other evidence to establish the owner's title to such materials and equipment. Responsibility for such stored materials and equipment shall remain with the contractor regardless of ownership title. Such stored materials and equipment shall not be removed from the owner's property. Should the space for storage on-site be limited, the contractor, at his option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the contractor desire to include any such materials or equipment in his application for payment, they must be stored in the name of the owner in a commercial warehouse approved by the designer and Owner and located as close to the site as possible. The warehouse selected must be approved by the contractor's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the contractor. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer and the owner prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the Owner absolute right to possession of the materials at anytime. Bond, security and insurance protection shall continue to be the responsibility of the contractor(s).

e. In the event of beneficial occupancy, retainage of funds due the contractor(s) may be reduced with the approval of the Owner to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one–half (2 2) times the estimated value of the work to be completed or corrected. Reduction of retainage must be with the consent and approval of the contractor's bonding company.

ARTICLE 32 – CERTIFICATES OF PAYMENT AND FINAL PAYMENT;

a. Within five (5) days from receipt of request for payment from the contractor, the designer shall issue and forward to the owner a certificate for payment. This certificate shall indicate the amount requested or as approved by the designer. If the certificate is not approved by the designer, he shall state in writing to the contractor and the owner his reasons for withholding payment.

b. No certificate issued or payment made shall constitute an acceptance of the work or any part thereof. The making and acceptance of final payment shall constitute a waiver of all claims by the owner except:

1. Claims arising from unsettled liens or claims against the contractor.

2. Faulty work or materials appearing after final payment.

3. Failure of the contractor to perform the work in accordance with drawings and specifications, such failure appearing after payment.

4. As conditioned in the performance bond and payment bond.

c. The making and acceptance of final payment shall constitute a waiver of all claims by the contractor except those claims previously made and remaining unsettled (Article 20(c)).

d. The designer will not authorize final payment until the work under contract has been certified by designer, and certificates of compliance issued (G.S. 133–1.1).

e. Final certificate of payment shall be accompanied by the following:

1. Warranties and guarantees required by the contract.

2. Release and waiver of claim for prime contractors.

3. Affidavit of contractors of payment to material suppliers and subcontractors. (See Article 36.)

4. Certificates of state agencies required by state law.

5. Certificate of compliance by designer.

6. Consent of surety to final payment.

ARTICLE 33 – PAYMENTS WITHHELD;

a. The designer with the approval of the Owner may withhold payment for the following reasons:

1. Faulty work not corrected.

2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.

3. To provide for sufficient contract balance to cover liquidated damages that will be assessed.

b. The Owner may authorize the withholding of payment for the following reasons:

1. Claims filed against the contractor or evidence that a claim will be filed.

2. Evidence that subcontractors have not been paid.

c. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the contractor without cause will make owner liable for payment of interest to the contractor as provided in G.S. 143–134.1.

ARTICLE 34 – MINIMUM INSURANCE REQUIREMENTS;

The work under this contract shall not commence until the contractor has obtained all required insurance and verifying certificates of insurance have been approved in writing by the owner. These certificates shall contain a provision that coverages afforded under the policies will not be canceled, reduced in amount or coverages eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner of such alteration or cancellation.

a. Worker's Compensation and Employer's Liability: The contractor shall provide and maintain, during the life of the contract, worker's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of $100,000.

b. Public Liability and Property Damage: The contractor shall provide and maintain, during the life of the contract, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury*:	$500,000 per occurrence
Property Damage*:	$100,000 per occurrence / $300,000 aggregate
*$500,000:	Combined single limit shall satisfy both conditions.

Such coverage for completed operations must be maintained for at least two (2) years following final acceptance of the work performed under the contract.

c. Property Insurance: The contractor shall purchase and maintain property insurance during the life of this contract, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the owner, the contractor, the subcontractors and subcontractors in the work and shall insure against the perils of fire, extended coverage, and vandalism and malicious mischief. If the owner is damaged by failure of the contractor to purchase or maintain such insurance, then the contractor shall bear all reasonable costs properly attributable thereto; the contractor shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions.

d. Deductible: Any deductible, if applicable to loss covered by insurance provided, is to be borne by the contractor.

e. Other Insurance: The contractor shall obtain such additional insurance as may be required by the owner or by the General Statutes of North Carolina including motor vehicle insurance, in amounts not less than the statutory limits.

f. Proof of Carriage: The contractor shall furnish the owner with satisfactory proof of carriage of the insurance required before written approval is granted by the owner.

ARTICLE 35 – PERFORMANCE BOND AND PAYMENT BOND;

a. Each contractor shall furnish a performance bond and payment bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount. Bonds shall be executed in the form bound with these specifications (Section 307 and Section 308).

b. All bonds shall be countersigned by an authorized agent of the bonding company who is licensed to do business in North Carolina.

ARTICLE 36 – CONTRACTOR'S AFFIDAVIT;

The final payment of retained amount due the contractor on account of the contract shall not become due until the contractor has furnished to the owner through the designer an affidavit signed, sworn and notarized to the effect that all payments for materials, services or subcontracted work in connection with his contract have been satisfied, and that no claims or liens exist against the contractor in connection with this contract. In the event that the contractor cannot obtain similar affidavits from subcontractors to protect the contractor and the owner from possible liens or claims against the subcontractor, the contractor shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the contractor's) knowledge, and if any appear afterward, the contractor shall save the owner harmless.

ARTICLE 37 – ASSIGNMENTS;

The contractor shall not assign any portion of this contract nor subcontract in its entirety. Except as may be required under terms of the performance bond or payment bond, no funds or sums of money due or become due the contractor under the contract may be assigned.

ARTICLE 38 – USE OF PREMISES;

a. The contractor(s) shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the designer and shall not exceed those established limits in his operations.

b. The contractor(s) shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

c. The contractor(s) shall enforce the designer's instructions regarding signs, advertisements, fires and smoking.

ARTICLE 39 – CUTTING, PATCHING AND DIGGING;

a. The contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon or reasonably implied by the drawings and specifications for the completed structure, as the designer may direct.

b. Any cost brought about by defective or ill-timed work shall be borne by the party responsible therefor.

c. No contractor shall endanger any work of another contractor by cutting, digging or other means. No contractor shall cut or alter the work of any other contractor without the consent of the designer and the affected contractor(s).

ARTICLE 40 – UTILITIES, STRUCTURES, SIGNS;

a. The project expediter shall provide necessary and adequate facilities and pay all costs for water, electricity,

gas, oil, sewer and other utility services which may be necessary and required for completion of the project according to the contract documents. Any permanent meters installed shall be listed in the project expediter's name until his work is fully accepted by the owner.

b. Meters shall be relisted in the owner's name on the day following completion and acceptance of the project expediter's work, and the owner shall pay for services used after that date.

c. The owner shall be reimbursed for all metered utility service charges paid by or attributed to the owner after the meter is relisted in the owner's name and prior to completion and acceptance of the work of all contractors. Reimbursement shall be made by the contractor whose work has not been completed and accepted. If the work of two or more contractors has not been completed and accepted, reimbursement to the owner shall be paid by the contractors involved on the basis of assessments by the designer.

d. All contractors shall have the permanent building systems in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed. The HVAC systems shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishes of the building. A building shall be considered enclosed when it has windows installed and when doorways and other openings have protection which will provide reasonable climatic control. The appropriate climatic condition shall be jointly determined by the contractor(s) and the designer. Use of the equipment in this manner shall in no way affect the warranty requirements of the contractor(s).

e. The electrical contractor shall have the building's permanent power wiring distribution system in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.

f. The electrical contractor shall have the building's permanent lighting system ready at the time the general contractor begins interior painting and shall provide adequate lighting in those areas where interior painting and finishing is being performed.

g. Each prime contractor shall be responsible for his permanently fixed service facilities and systems in use during progress of the work. The following procedures shall be strictly adhered to:

1. Prior to acceptance of work by the owner, each contractor shall remove and replace any parts of the permanent building systems damaged through use during construction.

2. Temporary filters shall be installed in each of the heating and air conditioning units during construction. New filters shall be installed in each unit prior to the owner's acceptance of the work.

3. Extra effort shall be maintained to keep the building clean and under no circumstances shall air systems be operated if finishing operations are creating dust in excess of what would be considered normal if the building were occupied. The designer may require that return grilles in the habitable space also be covered with filter media. The intent is to present the duct system in a clean condition at final inspection.

4. It shall be understood that any warranty on equipment presented to the owner shall extend from the day of final acceptance by the owner. The cost of warranting the equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.

5. The electrical contractor shall have all lamps in proper working condition at the time of final project acceptance.

h. The project expediter shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.

I. The project expediter shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.

j. The project expediter will erect one sign on the project if required. The sign shall be of sound construction, and shall be neatly lettered with black letters on white background. The sign shall bear the name of the project, and the names of prime contractors on the project, and the name of the designer and consultants. Directional signs may be erected on the owner's property subject to approval of the owner with respect to size, style and location of such directional signs. Such signs may bear the name of the contractor and a directional symbol. No other signs will be permitted except by permission of the owner.

ARTICLE 41 – CLEANING UP;

The contractors shall keep the building and surrounding area reasonably free from rubbish at all times, and shall remove debris from the site from time to time or when directed to do so by the designer. Before final inspection and acceptance of the building, each contractor shall clean his portion of the work, including glass, hardware, fixtures, masonry, tile and marble (using no acid), clean and wax all floors as specified, and completely prepare the building for use by the owner, with no cleaning required by the owner.

ARTICLE 42 – GUARANTEE;

a. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturer's warranty period.

b. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the final acceptance of the work and shall replace such defective materials or workmanship without cost to the owner.

c. Additionally, the owner may bring an action for latent defects caused by the negligence of the contractor which is hidden or not readily apparent to the owner at the time of final acceptance, in accordance with applicable law.

d. Roof guarantees are stipulated in the roofing specification.

ARTICLE 43 – CODES AND STANDARDS;

Wherever reference is given to codes, standard specifications or other data published by regulating agencies including, but not limited to, national electrical codes, North Carolina state building codes, federal specifications, ASTM specifications, various institute specifications, etc., it shall be understood that such reference is to the latest edition including addenda published prior to the date of the contract documents.

ARTICLE 44 – INDEMNIFICATION;

To the fullest extent permitted by law, the contractor shall indemnify and hold harmless the owner, the designer and the agents, consultants and employees of the owner and designer, from and against all claims, damages, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance or failure of performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the contractor, the contractor's subcontractor, or the agents of either the contractor or the contractor's subcontractor. Such obligation shall not be construed to negate, abridge or otherwise reduce any other right or obligation of

indemnity which would otherwise exist as to any party or person described in this article.

ARTICLE 45 – TAXES;

State Use and Sales Taxes shall be included in the Bid. The Contractor shall submit each month, with his payment request, a Sales Tax Report showing Sales Tax paid, as set forth herein. Sales tax report shall be itemized on a form showing name and address of supplier, invoice number, date, material description, gross amount, State Sales Tax, County Sales Tax, invoice total, and grand total. Sales Tax Reports shall be signed and notarized.

ARTICLE 46 – EQUAL OPPORTUNITY CLAUSE;

The non–discrimination clause contained in Section 202 (Federal) Executive Order 11246, as amended by Executive Order 11375, relative to equal employment opportunity for all persons without regard to race, color, religion, sex or national origin, and the implementing rules and regulations prescribed by the secretary of Labor, are incorporated herein.

ARTICLE 47 – EMPLOYMENT OF THE HANDICAPPED;

The contractors agree not to discriminate against any employee or applicant for employment because of physical or mental handicap in regard to any position for which the employee or applicant is qualified. The contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices.

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM);

The Owner has attempted to address all asbestos-containing materials that are to be disturbed in the project. However, there may be other asbestos-containing materials in the work areas that are not to be disturbed and do not create an exposure hazard. Contractors are reminded of the requirements of instructions under Instructions to Bidders and General Conditions of the Contract, titled Examination of Conditions. Statute 130A, Article 19, amended August 3, 1989, established the Asbestos Hazard Management Program that controls asbestos abatement in North Carolina.

SUPPLEMENTARY GENERAL CONDITIONS

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS:

Supplement:

All work shall conform to Contract Documents. No change there from shall be made without Contractor having first received permission from Engineer, in writing, to make such change. Where detailed information is lacking, Contractor, before proceeding with work, shall refer matter to Engineer who will furnish information with reasonable promptness.

If any errors or omissions appear in Contract Documents, Contractor shall, after discovering same, notify Engineer in writing of such error or omission.

Drawings for this project consist of: M0.1, M0.2, M1.0, M2.0

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS:

Supplement:

If, in the Contractor's opinion, any work is indicated on Drawings, or is specified in such manner as will make it impossible to produce a first-class piece of work, or should discrepancies appear between Drawings and Specifications, he shall refer same to Engineer for interpretation before proceeding with work. If Contractor fails to make such reference, no excuse will thereafter be entertained for failure to carry out work in satisfactory manner.

Should a conflict occur in or between Drawings and Specifications, CONTRACTOR SHALL BE DEEMED TO HAVE ESTIMATED ON MORE EXPENSIVE WAY OF DOING WORK unless he shall have asked for and obtained a decision, in writing, from Engineer before submission of proposals as to which method or materials will be required.

ARTICLE 14 - CONSTRUCTION SUPERVISION:

Supplement:

Prior to and during the execution of the work, the Contractor shall check all drawings, specifications, and job conditions and shall immediately report any errors, discrepancies, conflicts and omissions found therein to the Engineer in writing and have the same explained or corrected by the Engineer before proceeding with the work. Any work done by the Contractor after these conditions have been discovered and before the Engineer has explained or made corrections shall be corrected at the Contractor's expense.

Contractor shall verify all dimensions as indicated on drawings. He shall report any errors or inconsistencies in writing above to the Engineer before commencing work and any necessary changes shall be adjusted as provided by Article 19 "Changes in the Work".

In the event that the Contractor does not verify all dimensions he shall bear the cost of any necessary changes resulting there from.

ARTICLE l5 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS:

Shall be as follows: Mechanical Construction (Single Prime)

All work, including any incidental cutting and patching, repairs to existing finishes as a result of Contractor’s

operations, and any other work necessary to the proper execution of this Contract shall be the responsibility of the Contractor.

ARTICLE 23 - TIME OF COMPLETION, DELAYS, EXTENSIONS OF TIME: **

Supplement:

The "Construction Schedule" shall be in graph form and show the date when every major operation is to begin and to be completed, the dollar value to be completed, the dollar value to be completed each month and the date when approved shop drawings will be needed.

"Construction Schedule" shall be brought up to date and submitted each month with the application for payment.

An additional copy of the "Construction Schedule" shall be provided the Engineer for forwarding to the Owner.

All work must be completed in accordance with the Project Schedule which is described in Article 60 of these Supplementary General Conditions.

ARTICLE 31 - REQUEST FOR PAYMENT:

Supplement: The Contractor shall submit to the Engineer for approval promptly after the award of the contract, a complete schedule of values of the various parts of the work, broken down to show labor and material values for each school. The various parts of the work shall be listed with their proportional value. This schedule shall be used for the basis for monthly payments.

The Contractor may submit to the Engineer an "Application and Certificate for Payment" on A.I.A. Form 702, each month if he wishes to be paid for work accomplished in the previous month. The Contractor shall attach to the Application any receipts or vouchers required to verify same.

The application, when approved by the Engineer, shall be certified within a reasonable time to the Owner for payment. No payment made to the Contractor by the Owner shall constitute acceptance of any work or materials not conforming to the Contract.

Revise paragraph a.3. as follows:

3. Less five percent (5%) retainage, provided however, that after fifty percent (50%) of the work has been satisfactorily completed on schedule, with approval of the Owner and written consent of the surety, retainage may be reduced to zero percent (0%) only so long as work continues to be completed satisfactorily and on schedule.

ARTICLE 39 - CUTTING, PATCHING, AND DIGGING:

Supplement:

It is the general intent of these drawings and specifications that patching of walls, floors, partitions, roofs, ceilings, or other materials necessary and required to affect the completion of work as required to install work by the contractor will be the responsibility of said contractor, except as otherwise specifically required by the accompanying drawings and specifications. The repair of all damages made by cutting shall include restoring those surfaces to their original state of finish. All such repairs shall be performed by personnel trained and proficient in the particular trades involved; i.e., plaster repairs by plasterers, masonry repairs by masons, tile repairs by tile setters, etc., who shall be approved in advance by the Engineer.

It is the intent of this specification that all areas requiring repairs shall be restored to a completely finished

condition, acceptable to the Engineer and Owner, by this Contractor.

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS:

Utilities, including electric power and water for construction purposes will be provided by the Owner from existing facilities. The Contractor shall consult with the Owner as to the source of power.

Contractor to provide portable toilet facilities located on site outside building. If approved by Henderson County, the Contractor may utilize Owner designated toilet facilities within the building areas under renovation at the time as long as maintained in satisfactory sanitary condition

ARTICLE 50 - MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS:

All manufactured articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accord with manufacturer's specifications and directions, unless herein specified to the contrary.

ARTICLE 51 - PHYSICAL DATA:

The drawings have been prepared on the basis of surveys and inspections of the site and are intended to present an essentially accurate general indication of the physical conditions at the site. This, however, shall not relieve the Contractor of the necessity for familiarizing himself with the physical conditions at the site. Any discrepancies found in the drawings shall be reported to the Engineer.

The Contractors and subcontractors shall verify all levels, dimensions, angles, and conditions at the site before ordering any material or executing any work and shall be responsible for the correctness of his measurements. Any difference which may be found, shall be submitted to the Engineer for consideration and adjustment before proceeding with the work.

ARTICLE 52 - DESCRIPTION OF PROJECT:

This project consists of replacement of the existing outdoor packaged water chiller at the Henderson County Historic Courthouse.

ARTICLE 54 - TIME OF COMPLETION AND LIQUIDATED DAMAGES:

The Contractor shall commence work to be performed under this agreement on a date to be specified in a written order from the Engineer and shall fully complete all work hereunder in accordance with the schedule outlined in Supplementary General Conditions Article 60. See General Conditions of the Contract, Article 23, regarding Construction Schedule, Delays and Extension of Time.

It is anticipated that overtime work / late shift work, and possibly weekend work will be required in order to complete this project within the specified duration, and to avoid disruption of the operations of the facilities. Any costs associated with overtime/weekend work are considered within the scope of work of this contract. Work schedule shall be fully coordinated with and approved by the Owner. Contractor shall follow all County policies regarding safety, security, and otherwise, when working while staff is not present. Contractor shall be responsible for all resulting loss / costs that may result (both their own, as well as, the owner’s) as a result of not complying with policies and agreed to procedures.

ARTICLE 55 - WORK IN OCCUPIED AREAS:

Contractor shall properly protect all furnishings and finishes in the building and stored in designated areas of the building by the Owner.

Where work is required to be done in occupied areas of the existing buildings the contractor shall consult with the Owner and arrange schedules mutually satisfactory to both parties for performing such work. Special consideration will be given to Owner's ability to schedule work in special areas or during times facilities are previously committed.

The Contractor shall take due precautions for protection of equipment and furnishings and shall expedite work to complete same in shortest possible time and minimum disruption of normal activities of Owner. Once installation is begun, it shall be completed without delay.

ARTICLE 56 - STORAGE:

Limited space for storage of materials and equipment will be provided and designated at the project site. The Contractor shall consult with the Owner who will designate specific areas mutually satisfactory to both parties for this purpose. If additional storage space is required, Contractor will be responsible for making arrangements for off-site.

ARTICLE 57 - PARKING:

Limited space for parking of Contractor's cars and trucks will be allotted free of charge by the Owner at the site of the work. The Contractor shall confer with the Owner who will designate specific spaces, the location and number of which are mutually satisfactory to both parties. If additional parking is required, Contractor will be responsible for making arrangements for off-site.

ARTICLE 58 - INTERPRETATIONS:

When Engineer gives or makes interpretations, contractor should not assume that he is being given oral instructions to make changes. No changes will be made except by written change order duly signed by the Owner, the Engineer, and Contractor; and the Contractor should not assume approval until he receives his duly executed copy.

ARTICLE 59 - PROJECT EXPEDITER:

It shall be the responsibility of the Prime Contractor for the project to schedule the work of all sub-contractors to maintain a progress schedule for all sub-contractors for this project; and to notify the Engineer of any changes in the progress schedule. He shall be responsible for providing adequate notice to all sub-contractors to ensure efficient continuity of all phases of the project work.

Project will have only one prime contractor; thus, the prime contractor will be designated the project expediter.

ARTICLE 60 – PROJECT SCHEDULE:

The contractor is expected to maintain chilled water service to the Historic Courthouse at all times as practical and possible, when cooling load is likely to exist (i.e. temperatures outside above 70 deg. F) during replacement of the chiller, thus replacement of the chiller may have to be accomplished nights and weekends / or at a period where weather is favorable. In the event that an outage is unavoidable during unfavorable weather conditions, it must occur between the hours of 6:00 PM and 6:00 AM as possible.

The full contract period is 120 days from the notice to proceed.

ARTICLE 61 – RECYCLING:

Disposal of all material demolished from the premises, as well as all construction debris, is to be accomplished in complete accordance state law and local ordinances.

ARTICLE 62 – ALTERNATES:

None

SECTION 230020 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the General Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source, at no additional cost to the Owner.

D. ***Refer to FM Guidelines which are included with the project specifications manual for FM requirements for this facility. FM standards are included so as to be part of the project requirements / specifications. Where conflicts exist between any spec. sections and the FM Guidelines and requirements, please notify the Architect / Engineer immediately.***

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. All work performed shall be in accordance with the latest requirements of the current edition of the North Carolina State Building Code, and all other state and local codes, rules, regulations, ordinances, and standards.

B. Contractor shall notify Designer in writing prior to receipt of bids if Contractor notes any discrepancy between laws, codes, ordinances, rules, regulations, and these specifications

C. In cases where the drawings or specifications exceed requirements of codes, standards, and ordinances, work shall be done in accordance with the requirements of the specifications.

D. Any work installed in violation of codes, standards, and ordinances shall be reworked to be in compliance with codes, standards, and ordinances, at Contractor’s expense.

END OF SECTION 230020

SECTION 230100 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

1.2 PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.3 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, submit documentation, including illustrations, from a qualified testing and inspecting agency, showing each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

C. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems bearing classification marking of qualified testing and inspecting agency.

B. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application on Drawings or that are produced by one of the following manufacturers:
   1. Specified Technologies, Inc. (STI)
   2. Others as Approved by Owner / Engineer.

2.2 FIRESTOPPING

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.

PART 3 - EXECUTION

3.1 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 FIELD QUALITY CONTROL

A. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

END OF SECTION 230100

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General provisions.
   2. Scope.
   3. Permits and Fees.
   4. Visit to Job Site.
   5. Workmanship.
   6. Drawings and Specifications.
   7. Tests.
   8. Allowance for added work.
   9. Incidental construction work.
   10. Access Doors.
   11. Supervision.
   12. Electrical work by others.
   13. Existing facilities, utilities, etc.
   14. Adaptation of work to existing conditions.
   15. Renovations/alterations.
   16. Submittal procedures.
   17. Product requirements.
   18. Closeout procedures.
   19. Operation and Maintenance Manuals.
   20. As-built Documents.
   21. Demonstration and Training.
   22. Warranty.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL PROVISIONS

A. This Contractor's attention is directed to the requirements of Instructions to Bidders, General Conditions and Supplementary General Conditions as bound in the specifications which apply in full to the HVAC work.

B. Where the requirements of this Division conflict with other articles in these Specifications, the Contractor shall utilize the more stringent method.

3.2 SCOPE

A. Provide all labor, materials, tools, equipment, and transportation, and perform all operations necessary for and reasonably incidental to proper execution and completion of all "HVAC" work, whether specifically mentioned or not, all as indicated, specified herein, and/or implied thereby to carry out the apparent intent thereof.

B. These drawings may be superseded by later revised or detailed drawings, specifications, or sketches prepared by the Designer, as needed for clarification, and this Contractor shall conform to all reasonable coordination requests.

C. All items not specifically mentioned in the specifications or noted on the drawings, but which obviously are required to make the working installation complete, shall be included automatically.

D. For projects which are bid or awarded as Single Prime contracts, organization of the Specifications into divisions, sections, and articles, and arrangement of the Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be done by any trade, unless specifically shown or noted otherwise.

3.3 PERMITS AND FEES

A. This Contractor shall secure all permits required for the completion of this contract. He shall obtain and deliver to the Owner all certificates of inspection issued by the authorities having jurisdiction.

3.4 VISIT TO JOB SITE

A. Before submitting a bid, this Contractor shall visit the job site for the purpose of thoroughly examining the site and conditions under which the work must be performed.

B. The submission of a bona fide bid will be construed to mean that this Contractor understands and is satisfied with conditions under which the contract must be fulfilled.

C. No extra compensation will be allowed for situations arising from failure of this Contractor to be thoroughly familiar with site conditions, including charges and requirements for connection to utilities as shown for this project.

3.5 WORKMANSHIP

A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved.
B. Work shall be performed by experienced and skilled mechanics under the supervision of a competent foreman.
C. Substandard workmanship will be cause for rejection of work and replacement by Contractor.
D. The Contractor shall reimburse the Designer for all costs incurred by the Designer due to Contractor’s substandard or non-conforming work.

3.6 DRAWINGS AND SPECIFICATIONS

A. The drawings show the location and arrangement of fixtures, piping, and equipment, together with details of connections of certain principal items.
B. The layout shown shall be followed as closely as circumstances will permit, but this Contractor shall lay out his work so as to avoid conflict with other Contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members.
C. This Contractor shall carefully and accurately locate all sleeves and install at the proper time all necessary hangers, inserts, etc., which will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of above items.
D. This Contractor shall refer to architectural, mechanical, and electrical drawings and shall cooperate fully with other Contractors and trades while installing piping, fixtures, and other equipment because of close space limits.
    1. In case of conflict, notify Designer before proceeding with installation.
    2. Refer to architectural drawings for exact building dimensions and location of partition walls, doors, chases, etc.
    3. HVAC drawings are not to be scaled for such dimensions.
E. The drawings and specifications complement each other and together are intended to give a complete description of the work.
    1. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown in plans, shall be furnished the same as if mentioned or shown in both places.
    2. If conflicts exist, then the most stringent method shown or described shall apply.
F. Any switches, controls, or equipment included in this contract work (drawings and/or specifications) that are not specifically shown on drawings shall be located for convenient use and access.
G. Contractor shall coordinate all equipment arrangement and lay-out in field prior to beginning any actual installation of his work.
H. If Contractor notes any discrepancy, omission, or conflict found in plans or specifications, he shall call to the immediate attention of the Designer, prior to receipt of bids.
I. It is the intention that piping, air ducts and light fixtures are designed and laid out to clear each other.
    1. It shall be the responsibility of this Contractor to coordinate his work with that of other trades to avoid any such conflicts.
    2. Any conflicts that occur after work of one trade is installed and was not prior coordinated shall be relocated or rearranged at the total expense of this Contractor, as directed by Designer.
    3. Any conflicts that cannot be corrected in field by relocation or elevation changes shall be reported to the Designer in writing prior to any installation.
J. The drawings are not intended to show each and every complete or accurate detail.
    1. The figures and writing on drawings shall be taken instead of scaling.
    2. It is this Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement.
    3. This Contractor shall take and be responsible for all field measurements.
    4. Exact locations and relations are to be defined in the field and shall be satisfactory to the Designer.
K. Because of the small scale of HVAC drawings it is not possible to indicate all offsets, fittings, and accessories which may be required.

1. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings and accessories that may be required to meet the conditions.

3.7 TESTS

A. The Designer reserves the right to conduct acceptance tests of all equipment, piping, or any other work furnished under these specifications to determine the fulfillment of special requirements.
   1. Such tests shall be conducted in the presence of authorized representatives of the Contractor, Owner, Engineer, and Architect at such time as the Designer may designate.
   2. This Contractor shall perform all tests, bear cost of same and make adjustments of equipment and wiring as may be deemed necessary by the Designer.

3.8 ALLOWANCE FOR ADDED WORK

A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall first be submitted and approved in writing.
   1. No claim for addition to the contract sum will be valid unless so ordered and approved by the Owner and Designer, prior to start of work.
   2. Any conflicts corrected by relocation or elevation changes do not constitute extra work.

3.9 INCIDENTAL CONSTRUCTION WORK

A. All blocking for openings for piping in concrete floors, masonry walls or partitions shall be provided by this Contractor.
   1. This Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications.
   2. He shall properly complete and finish up his work after other Contractors have finished as the Designer may direct.

B. All excavating required for the installation of this system shall be done by this Contractor.
   1. Backfill shall be accomplished as specified in appropriate section of specifications.

C. Chases are prohibited in masonry walls which are not to be plastered or paneled.
   1. Set piping, blocking, carriers, etc. indicated to be concealed before walls are constructed in order that walls may be constructed around them.
   2. This Contractor shall furnish all sleeves in floors, beams, walls, etc., for each such penetration as needed for installing his work and installation of sleeves by General Contractor.

D. Unless otherwise noted, the General Contractor will provide openings and lintels as new construction progresses, but this Contractor shall fully designate his requirements prior to construction.
   1. Failure to furnish his requirements prior to building construction and failure to coordinate his work with the building construction shall make this Contractor responsible for removing, replacing and painting building construction as required for installation of his work.

3.10 ACCESS DOORS

A. Provide and install access doors in walls, ceilings, etc. as required for access to valves, dampers, fire dampers, controls, and other devices requiring access in ceilings, chases, soffits, etc.

B. Access doors in non-fire rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. 16-gage steel frame with 14-gage door panel and galvanized steel drywall bead.
   3. Flush style with provision to conceal flange with drywall cement.
   4. Double-acting concealed spring hinges to allow opening to 175 degrees.
   5. Flush, Allen-head operated with steel cam.
   6. Gray prime-painted steel, for painting to match adjacent finished surfaces.
   7. Basis of Design: Milcor Style DW; Comparable Products by Karp, Elmdor, Acudor.

C. Access doors in fire-rated walls or ceilings shall be as follows:
   1. Nominal 24” x 24” minimum size.
   2. UL 1-1/2 hour, Class B fire rating.
   3. Prime-painted stainless steel: 16-gage frame with 20-gage door panel, for painting to match adjacent finished surfaces.
   4. 2” mineral fiber insulation between inner and outer panel.
   5. Continuous hinge, steel with stainless steel pin.
   6. Self-closing and self-latching panel closer.

7. Flush mounted paddle latch and locking system with flush, key-operated cylinder lock with two keys.
8. Basis of Design: Milcor Style UFR; Comparable Products by Karp, Elmdor, Acudor.

3.11 SUPERVISION

A. This Contractor shall have in charge of the work at all times during construction a thoroughly competent foreman with extensive experience in the work to be performed under this contract.
   1. Anyone deemed not capable by the Designer shall be replaced immediately upon request, and after satisfactory foreman has been assigned, he shall not be withdrawn without the written consent of the Designer.

3.12 ELECTRICAL WORK BY OTHERS

A. Refer to the drawings for the details of locations of circuit breakers, junction boxes, disconnect switches, conduits and slack wire required where this contractor's electrical work terminates and electrical work by others begins.
B. The Electrical Contractor shall furnish and install all power circuits for equipment furnished by others.
C. In Mechanical Rooms the wiring by the Electrical Contractor shall generally terminate in a power wiring gutter, line side of disconnect switches or starters, junction box, or electrical panel.
   1. From these points power wiring to the equipment furnished by the HVAC Contractor shall generally be by the HVAC Contractor.
   2. Power wiring to mechanical equipment outside equipment rooms will generally be run by the Electrical Contractor to line side of a disconnect switch or junction box in the vicinity (within 3'-0") of the HVAC equipment.
   3. Power wiring from that point to the equipment will be by the HVAC Contractor.
D. HVAC Contractor is to refer to the drawings for location and type of service connections to be provided under the electrical contract.
   1. Where service disconnect switches are required and not furnished as part of the equipment, they shall be furnished and installed by contractor that furnishes the equipment, unless indicated otherwise.
   2. Other Contractors shall furnish and install conduit, boxes, wiring and all items of control for equipment they furnish or Owner furnished equipment, unless specifically shown on electrical drawings.

3.13 EXISTING FACILITIES

A. In existing facilities, disruption of operations must be kept to a minimum and coordinated with Owner.
   1. Work in existing buildings must be cleaned up daily immediately after finishing that portion of work and equipment left in order for Owner to continue operations.
   2. When it is necessary to interrupt utility services in the fulfillment of this contract, such interruptions shall be kept to a minimum and coordinated with Owner.
   3. Once work has begun, it shall be pursued diligently until completed.
B. Every precaution shall be taken to prevent damage to existing underground lines and structures and public utilities.
   1. Damage to existing water and sewer lines, culverts, service connections, underground cables, and similar surface and sub-surface structures shall be at the risk of this Contractor, whether or not locations thereof are shown on plans, and the repairing of such damage shall be by this Contractor and shall be completed without delay.
   2. Compensation for such repairs shall be based on normal and reasonable costs.
C. The locations of any existing underground utilities that are shown are in an approximate way only and have not been independently verified by the Owner or its representative.
   1. The Contractor shall determine the exact location of all existing utilities before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor’s failure to exactly locate and preserve any and all underground utilities.

3.14 ADAPTATION OF WORK TO EXISTING CONDITIONS

A. It is reasonably implied that this Contractor shall furnish all labor and materials to provide Owner with a new and satisfactory system in these facilities.
   1. Contractor is to include necessary work for adaptation of equipment to conditions that may be found to produce conflicts during construction.

2. When any such conditions are encountered, this Contractor is to consult with Designer and then modify installation as directed without additional costs, and to include any incidental materials required.

3.15 RENOVATIONS/ALTERATIONS

A. Before any work is started in existing building, HVAC Contractor shall make a thorough survey with Designer and a representative of the Owner of building in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by all three to Designer. This report shall list by rooms and spaces:
   1. Existing conditions and types of resilient flooring, doors, windows, wall and other surfaces not required to be altered throughout and affected areas of building.
   2. Existence and conditions and operation of items such as HVAC fixtures, water heaters, valves, etc., required by drawings to be either reused for relocated, or both.
   3. Any discrepancies between drawings and existing conditions at site.
   4. Areas for working space, materials storage and routes of access to areas within buildings where alterations occur and which have been agreed upon by Contractor and Designer.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Designer and Owner's representative, to be in such condition that their use is impossible or impractical, shall be removed and a proposal submitted by Contractor to replace with new items in accordance with specifications which will be furnished by Designer.

C. Re-Survey: Fifteen days before expected partial or final inspection date, Contractor, Designer, Owner's representative, together shall make a thorough re-survey of the areas of buildings involved.
   1. They shall furnish a report on conditions then existing, of HVAC fixtures, equipment, etc. as compared with conditions of same as noted in first condition survey report.
   2. Re-survey report shall also list any damage caused by this Contractor to such flooring and other surfaces, despite protection measures; and, will form basis for determining extent of repair work required of this Contractor to restore damage caused by Contractor's workmen in executing work of this Contract.

3.16 SUBMITTAL PROCEDURES

A. Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   3. Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Contractor approval: Affix review stamp to cover sheet, with initials and date of Contractor’s approval of submittals.
   1. By submitting Shop Drawings, Product Data, Samples and similar submittals, this Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria and details related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Contract Documents and the Work of other trades.

C. Comply with requirements in Division 01 Sections for list of submittals and time requirements for scheduled performance of related construction activities.

D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows.
   1. Time for review shall commence on Designer's receipt of submittal.
   2. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   3. Allow 21 days for initial review of each submittal.
      a. Allow additional time if coordination with subsequent submittals is required.
      b. Designer will advise Contractor when a submittal being processed must be delayed for coordination.
   4. Allow 15 days for review of each resubmittal.

E. Identification: Identify submittals as required in Division 01 sections.

F. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
   1. Summarize deviations on transmittal or List of Deviations included with submittal.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling.
   1. Transmit each submittal using a transmittal form.
   2. Designer will discard submittals received from sources other than Contractor.

I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked "Furnish as Submitted" or "Furnish as Corrected."
   4. Where submittals contain specific questions or comments, provide a separate sheet with specific answers to each question or comment.

J. At Contractor's written request, copies of Designer's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Allow 21 days from Designer's receipt of written request for CAD files for delivery of files
   2. Files will be delivered via email or compact disc.
   3. Files will be delivered without RN&M Title Blocks, standard details, schedules, etc.
   4. CAD files provided for Contractor's use are not to be construed as the Contract Documents. Use of CAD files for submittals or other uses are at the Contractor's risk.

K. Prepare and submit Action Submittals required by individual Specification Sections.
   1. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   2. Number of Copies: Submit at least eight copies of Product Data, unless otherwise indicated.
      a. Designer will return all but three copies.
      b. Retain or duplicate sufficient copies for inclusion in Operation and Maintenance Manuals.
   3. Shop Drawings: Prepare Project-specific information, drawn accurately to scale.
      a. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Designer's CAD Drawings is otherwise permitted.
   5. Sheet Size: At least 8-1/2 by 11 inches but no larger than size of project drawings.
   7. Number of Copies: Two opaque (bond) copies of each submittal. Designer will return one copy.
   8. Manufacturers and Materials Suppliers List: Submit three copies of manufacturers and materials suppliers list within 20 days of Contract Award, unless otherwise indicated. Designer will return two copies.
   10. Subcontract List: Submit within 20 days of Contract Award three copies of list of proposed subcontractors. Designer will return two copies. Subcontract list to include all tiers of subcontractors.

L. Contractor's Review and Approval: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents.
   1. Note corrections and field dimensions.
   2. Mark with approval stamp before submitting to Designer.

M. Designer's Action: Designer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
   1. Designer will review each submittal, make marks to indicate corrections or modifications required, and return it.
   2. Designer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
      a. Furnish as Submitted
      b. Furnish as Corrected: Incorporate comments marked on or attached to submittal.
      c. Revise and Resubmit: Major items of the submittal do not comply, requiring a resubmittal.

N. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

O. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

P. The Contractor is responsible for compliance with the Contract Documents, dimensions, details, coordination, and satisfactory performance of materials and equipment provided and installed.

3.17 PRODUCT REQUIREMENTS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Basis-of-Design Product: Item identified by manufacturer's product name, make, and model number, used to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, dimensions, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
   2. Comparable Product: Product that is listed in the Contract Documents, or added by Addendum, and demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified or basis-of-design product.
   3. Owner-preferred Alternate Product: Product that is listed in the Contract Documents, and for which an Alternate Bid price is submitted. When an Alternate Bid item is accepted in the Contract, no substitutions will be allowed.
   4. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of Contract.
   5. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product Requests: Submit three copies of each request for consideration, at least 10 days prior to receipt of bids, for products not listed in the Contract Documents. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Documentation: Show compliance with requirements for Comparable Products and the following, as applicable:
      a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed product.
      b. Detailed comparison of significant qualities of proposed product with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
      c. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   2. Designer's Action: If necessary, Designer will request additional information or documentation for evaluation. Designer will notify Contractor of approval or rejection of proposed comparable product request.
      a. Form of Approval: Addition of the item to the list of Comparable Products by Addendum, prior to receipt of bids.
      b. Use product specified if Designer cannot make a decision on use of a comparable product request within time allocated.

C. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, features, options, and other items needed for a complete installation and indicated use and effect, and as required or recommended by the manufacturer for a complete installation, whether or not specifically indicated on the drawings or specifications.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Designer will make selection.
   5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

D. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named.

E. Responsibility of the Contractor: The responsibility for determining dimensions, utility requirements, fitting of work with other trades, sequencing and coordination of work, for Product Substitutions and Comparable Products rests solely with the Contractor.

F. Manufacturer's Warranties: Where specifications require manufacturer's warranties, the provisions of the Contract Documents take precedence over any manufacturer's "standard" warranty provisions, exclusions, etc.
   1. The start of manufacturer's warranties shall be the date of Substantial Completion of the project or phase of the project, notwithstanding any language or exclusion in any document submitted by the contractor or manufacturer.

3.18 CLOSEOUT PROCEDURES

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Complete startup testing of systems.
   3. Submit test records.
   4. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   5. Complete final cleaning requirements, including touchup painting.
   6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   7. Submit a written request for inspection for Substantial Completion. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   8. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   9. Results of completed inspection will form the basis of requirements for Final Completion.

B. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit certified copy of Designer's Substantial Completion inspection list of items to be completed or corrected (punch list). The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit documentation of training.
   3. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Designer will either proceed with inspection or notify Contractor of unfulfilled requirements.
   4. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

C. Cleaning: This Contractor shall provide all systems and equipment in a new and clean condition.
   1. Clean all items furnished and installed in accordance with manufacturer's recommendations.
   2. Provide instruction to Owner in proper cleaning of all items provided as part of this Division.
   3. Cooperate with General Contractor in cleaning of building.

3.19 OPERATION AND MAINTENANCE MANUALS

A. Submit four complete copies of Operation and Maintenance Manuals to Designer for review prior to request for inspection for Substantial Completion.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.

C. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Name and address of Engineer.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. List of Material Suppliers and Subcontractors: List contact information for each material supplier and subcontractor.

F. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

G. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

H. Descriptions: Include the following: Product name and model number, Manufacturer's name, Equipment identification with serial number of each component, Equipment function, Operating characteristics, Limiting conditions, Performance curves, Engineering data and tests, complete nomenclature and number of replacement parts.

I. Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.

J. Describe the sequence of operation, and diagram controls as installed.

K. List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

L. Provide manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:

M. Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:

N. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

O. Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
P. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
Q. Provide complete approved submittal data with all annotations.
R. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

3.20 AS-BUILT DOCUMENTS

A. As-built Marked Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally.
2. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up As-built Marked Prints.
3. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
4. Record data as soon as possible after installation.
5. Record and check the markup before enclosing concealed installations.
6. Indicate dimensions to locate underground and concealed conduits and lines from fixed reference points.
7. Indicate burial depth for underground lines.
8. Indicate location of all valves and cross-reference to valve tag list.
9. Mark the Contract Drawings completely and accurately.
a. Mark record sets with erasable, red-colored pencil.
b. Note Addendum numbers, Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
10. Maintain As-built Marked Prints in a clean, legible, up-to-date condition in the project office, and available to the Designer for inspection upon request throughout construction.

B. Record Specifications: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and As-built Marked Prints where applicable.

3.21 DEMONSTRATION AND TRAINING

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner with at least seven days' advance notice.
C. Warranty service: Train Owner in repair and troubleshooting during each warranty service call.
D. For each training session, submit on letterhead name of trainer, date of training, names of Owner’s personnel trained, and systems/equipment trained on.
E. For factory training, documentation to be on letterhead of organization conducting training.

3.22 WARRANTY

A. This Contractor shall guarantee all materials, equipment, workmanship and each and every piece of apparatus which he furnished and which he installs under this contract against defects and failures of any nature for a period of one year from date on which the system is accepted.
B. Apparatus furnished by this Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity specified on drawings or in the specifications.
C. Equipment manufacturers shall warrant equipment furnished for this project for same time span as installing contractors warranty period as set above and elsewhere in these specifications.
1. Warranty start date shall be as established by the Designer. Refer to General Conditions, Supplementary General Conditions, and Division 1 specifications for establishment of warranty start dates.

2. The provisions of the Contract Documents supersede and override any manufacturer's standard warranty provisions.

D. Upon notice from the Designer or Owner, Contractor shall immediately check system, make necessary repairs or adjustments as required; due to faulty workmanship, materials, faults, operation or equipment, without cost to the Owner, and instruct Owner in proper operation, adjustment, and care of systems.

E. During the one-year warranty period, the Contractor shall be responsible for all preventive maintenance, including routine lubrication, filter changing, inspections, and adjustments.
   1. Contractor shall provide all materials, consumables, equipment, supplies, filters, etc. required for preventive maintenance.
   2. Perform preventive maintenance in accordance with manufacturer's recommendations.
   3. During preventive maintenance, instruct Owner in proper preventive maintenance procedures.

F. The Contractor shall submit service call tickets, reports, or other documentation of each warranty service call to the Designer.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flexible expansion loops.
   2. Alignment guides and anchors.

1.2 SUBMITTALS

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

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing flexible expansion loops.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Welding certificates.

D. Product certificates.

E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
   2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

A. FLEXIBLE EXPANSION LOOPS
   1. Provide flexible expansion loops of size to match pipe size. Flexible loops shall consist of two flexible sections of hose and braid, two 90° elbows, and a 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application. Install and guide per manufacturer's recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Flex-Hose Co., Inc.
      b. Flexicraft Industries.
      c. Metraflex, Inc.
   3. Minimum Pressure Rating: 175 psig, unless otherwise indicated.

2.2 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Adsco Manufacturing, LLC.
      b. Advanced Thermal Systems, Inc.
      c. Flex-Hose Co., Inc.
      d. Flexicraft Industries.
      e. Flex-Weld, Inc.
      f. Hyspan Precision Products, Inc.
      g. Metraflex, Inc.
      h. Piping Technology & Products, Inc.
      i. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.
2. Expansion Plug: Zinc-coated steel.
3. Washer and Nut: Zinc-coated steel.

E. Concrete: Portland cement mix, 3000 psi minimum. Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

F. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion fittings and loops.

B. Attach guides to pipe and secure to building structure.

3.4 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 230516

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Thermometers.
   2. Gages.
   3. Flowmeters.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 SOLAR DIGITAL THERMOMETER

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
   1. Wika
   2. Weiss
   3. Weksler
B. Case: High impact ABS plastic.
C. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
D. Range: -50ºF to 300 ºF minimum, field switchable between Fahrenheit and Celsius.
E. Accuracy: Greater value of 1º or 1%.
F. Resolution: 0.1º.
G. Recalibration: Internal potentiometer.
H. Power: Solar photovoltaic elements. Thermometers to work down to one f.c. (10 lux) of available light.
I. Environmental Conditions
   1. Ambient Temperature: -30ºF to 140 ºF.
   2. Maximum Relative Humidity: 100%.
J. When located outdoors, provide and install weatherproof cover.

2.2 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.
B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
   1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
   2. Ernst Gage Co.
   3. Eugene Ernst Products Co.
   4. Miljoco Corp.
   5. Palmer - Wahl Instruments Inc.
   6. Trerice, H. O. Co.
   7. Weiss Instruments, Inc.
   8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
   9. WIKA Instrument Corporation.
B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
   1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
   2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
   3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
   4. Movement: Mechanical, with link to pressure element and connection to pointer.
   5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
   6. Pointer: Red or other dark-color metal.
   7. Window: Glass or plastic.
   8. Ring: Metal or plastic.
   9. Accuracy: Plus or minus ½ percent accuracy.

10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel ¼ turn ball valve.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install solar powered digital thermometers in piping as shown on Drawings.
B. Install bimetallic-actuated dial thermometers in the following locations on ductwork as shown on Drawings.

3.2 GAGE APPLICATIONS

A. Install pressure gages as shown on Drawings.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.
B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
E. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
B. Install a manifolded, bridged pressure gage at pumps and where shown on Drawings. Utilize ¼" schedule 40 iron pipe, ball valves (isolation on each side of the gauge), and single combination pressure gauge (positive and negative pressure indication), and snubber.
C. OWNER REQUIREMENT: Trumpet valves are not allowed.

3.5 ADJUSTING

A. Calibrate thermometers according to manufacturer's written instructions, after installation.

Adjust faces of meters and gages to proper angle for best visibility

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

GENERAL

1.1 SCOPE

A. This section includes valve specifications for all HVAC systems except where indicated.

1.2 SUBMITTALS

A. Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

1.3 DESIGN CRITERIA

A. Where valves are specified for individual mechanical services (i.e. hot water heating, chilled water cooling, etc.) all valves shall be of the same manufacturer unless prior written approval is obtained from Designer.

PRODUCTS

1.4 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

A. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

B. Valve Sizes: Same as upstream piping unless otherwise indicated.

C. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

F. MANUFACTURERS: Manufacturers and model numbers listed below establish a range of acceptable quality, construction, materials, and performance for each type of valve. Equal valves will be considered prior to receipt of bids.

3.2 WATER SYSTEM VALVES

A. All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.

B. BALL VALVES:

1. 2" and smaller: Two piece bronze body; threaded or soldered ends, as appropriate to the pipe material; stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded packing gland follower; blowout-proof stem; 600 psig WOG.
2. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
3. Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham S206/216.
4. 2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.

C. GATE VALVES:

1. 2" and smaller: Use ball valves; gate valves will not be accepted in sizes 2" and smaller.
2. 2-1/2" and larger: Use gate valves; ball or butterfly valves will not be accepted in sizes 2-1/2" and larger.

D. BUTTERFLY VALVES (**Not Accepted Unless Allowed by Owner – Coordinate**):
   1. 2" and smaller: Use ball valves; butterfly valves will not be accepted in sizes 2 inch and smaller.
   2. 2-1/2" and larger: Cast iron body; stainless steel shaft; Teflon, nylatron, or acetal bearings; EPDM resilient seat. Disk to be bronze, aluminum-bronze, nickel plated ductile iron, cast iron with welded nickel edge, or stainless steel. Ductile iron discs are not acceptable. Pressure rated to 150 psig. Valve assembly to be bubble tight to 150 psig with no downstream flange/pipe attached.
   3. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
   4. Use threaded lug type valves for installation with class 125/150 flanges.
   5. Valve shall provide bidirectional bubble tight shutoff at full rated pressure for dead end service without requiring a flange on the downstream side.
   6. Centerline series 200, DeZurik BGS II, Keystone Fig. 222, Nibco LD2000 (2-1/2”-12”)/LD1000 (14” and above), Victaulic 300 series (2-1/2”-12”)/709 series (14”-24”).
   7. Provide ten-position lever actuators for valves 6" and smaller. Provide worm gear operators for valves 8" and larger.
   8. Where butterfly valves are indicated or specified to be installed at the location of a flow sensing device, provide the butterfly valves with a memory stop.

E. GLOBE VALVES: Do not use globe valves for water service, except in temperature control applications.

F. SWING CHECK VALVES:
   1. 2" and smaller: Class 125, bronze body, threaded or soldered ends, regrindable seat, bronze disc, threaded cap, suitable for installation in a horizontal or vertical line with flow upward. Crane 137/1342, Hammond IB912/IB940, Lunkenheimer 2144/2145, Milwaukee 509/1509, Nibco T-413-B/S-413-B, Powell 578/1825, Stockham B-309/B-319.
   2. 2-1/2" and larger: Class 125, cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward. Crane 373, Hammond IR1124, Lunkenheimer 1790, Milwaukee F2974, Nibco F918, Powell 559, Stockham G-931.

G. SPRING LOADED CHECK VALVES:
   1. 2" and smaller: Class 125, bronze body, threaded, solder or wafer ends, bronze trim, stainless steel spring, teflon seat unless only bronze available. APCO 300 series, ConBraCo 61 series, Mueller 303BP, Nibco T-480-Y/S-480-Y, Val-Matic 1400 series.
   2. 2-1/2" and larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required. Valves with ductile iron in contact with the working fluid will not be accepted. APCO 600 series, Metraflex 900 series, Milwaukee 1800 series, Nibco F910 series, Val-Matic 1800 series, Victaulic series 716.

H. BALANCE VALVES (Note: Utilize where shown on drawings at pumps, cooling tower bypass, etc.. where field adjustment may be required periodically):
   1. 2" and smaller: Bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral check valves and seals, adjustable memory stop, suitable for 200 psig water working pressure at 250°F. Armstrong CBV, Bell & Gossett Circuit Setter Plus, Griswald Quickset, Illinois 6000 series, Nexus Orturi, Nibco 1710 Series, Taco Accu-Flo, Tour & Anderson STAS/STAD, Victaulic series 786/787.
   2. Include one bellows type differential pressure meter kit that includes a six inch diameter gauge with 270° arc readout and having an accuracy of ±1% of full scale or better and suitable for the differential pressures of the valves supplied for this project, over-range protection, color coded hoses not less than ten feet in length with brass connectors suitable for connection to the low and high pressure connections on the balance valves, instrument valving so meter can be vented and drained,

pressure and temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle.

3. 2-1/2" and larger: Use butterfly valves as specified in this section.

I. DRAIN VALVES: Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size as the blowdown connection.

J. COMBINATION SHUT-OFF, CHECK, AND BALANCE VALVES (Note: Utilize where shown on drawings at pumps, cooling tower bypass, etc.. where field adjustment may be required periodically):

1. 2 inch and larger: Cast or ductile iron body, threaded or flanged or grooved end connections, stainless steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and outlet pressure tappings, capable of being repacked under full line pressure, and suitable for a minimum working pressure of 175 psig at 240°F when used in hot water heating systems. Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi Purpose Valve, Thrush-Amtrol Tri-Flow.

K. Automatic Flow-Control Valves (Note: Utilize where shown on drawings at terminal units, vav boxes, ahu coils, etc.. where field adjustment will likely not be required periodically – if adjustment is required a new spring has to be furnished) :

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide AutoFlow, pressure independent, valve with: autoflow regulator / cartridge, ball valve, two p/t ports, unions, etc.. or a comparable product by one of the following:

    a. Flow Design Inc.
    b. Griswold Controls.

4. Body: Brass or ferrous metal.
5. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable. Contractor to furnish replacement springs (quantity as required) during construction to achieve final flow settings at equipment (where devices are utilized).
6. Combination Assemblies: Include bonze or brass-alloy ball valve.
7. Identification Tag: Marked with zone identification, valve number, and flow rate.
8. Size: Same as pipe in which installed.
9. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
10. Minimum CWP Rating: 175 psig (1207 kPa).
11. Maximum Operating Temperature: 200 deg F (93 deg C).

B. WATER PRESSURE REDUCING VALVES:

1. Brass or bronze body, diaphragm operated, with an integral anti-syphon check valve, inlet strainer, and adjustable reduced pressure range but pre-set for the scheduled pressure, 125 psig at 225°F. Bell & Gossett, Cash-Acme, or Watts.

C. WATER RELIEF VALVES:

1. Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for 125 psig water working pressure at 240° F and ASME stamped, with Btu capacity and set point as scheduled. Bell & Gossett, Cash-Acme, Consolidated, Kunkle, Watts.

4.2 NATURAL GAS SYSTEMS

A. SHUT OFF VALVES:

1. 2" and smaller: Ball valve, bronze body, threaded ends, stainless steel ball, full or conventional port, teflon seat, blowout-proof stem, two-piece construction, suitable for 150 psig working pressure, U.L. listed for use as natural gas shut-off.

2. 2-1/2" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.
3. 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.
4. DeZurik, Homestead, Rockwell, Walworth.

B. GAS PRESSURE REGULATORS:
1. 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150 psi W.O.G., -20°F to 150°F.

4.3 SPECIALTY VALVES AND VALVE ACCESSORIES

A. GAUGE VALVES:
1. Water Service: Use 1/4" ball valves.

B. STEM EXTENSIONS:
1. Provide stem extensions when valve operators interfere with pipe insulation.

EXECUTION

4.4 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
C. Examine threads on valve and mating pipe for form and cleanliness.
D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
E. Do not attempt to repair defective valves; replace with new valves.

4.5 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install chainwheels on operators for butterfly gate and globe valves located in equipment rooms, NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

4.6 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

4.7 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
B. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers: B-Line, Fee and Mason, Grinnell, Kindorf, Michigan Hanger, Unistrut, or approved equal.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers: Carpenter & Paterson, Inc., ERICO/Michigan Hanger Co., PHS Industries, Inc., Pipe Shields, Inc., Rilco Manufacturing Company, Inc., Value Engineered Products, Inc.
C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS
A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Available Manufacturers: Hilti, Inc., ITW Ramset/Red Head, Masterset Fastening Systems, Inc., MKT Fastening, LLC., Powers Fasteners.
B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.Available Manufacturers: B-Line Systems, Inc., Empire Industries, Inc., Hilti, Inc., ITW Ramset/Red Head, MKT Fastening, LLC., Powers Fasteners.

2.7 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS
A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS
A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use padded hangers for piping that is subject to scratching.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.

8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

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

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

3.6 PAINTING

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

END OF SECTION 230529

SECTION 230533 - HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes heat tracing with the following electric heating cables:
   1. Self-regulating, parallel resistance.
   2. All heat tracing runs shall be thermostatically controlled type (individually).

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
   1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable. Include plans, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

E. Warranty: Special warranty specified in this Section.

1.3 QUALITY ASSURANCE

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

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Chromalox, Inc.; Wiegard Industrial Division; Emerson Electric Company.
   2. Nelson Heat Trace.
   3. Raychem; a division of Tyco Thermal Controls.

B. Heating Element: Pair of parallel No. 16 AWG, tinned, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

C. Electrical Insulating Jacket: Flame-retardant polyolefin.

D. Cable Cover: Tinned-copper or Stainless-steel braid, and polyolefin outer jacket with UV inhibitor.

E. Maximum Operating Temperature (Power On): 150 deg F.

F. Maximum Exposure Temperature (Power Off): 185 deg F.

G. Maximum Operating Temperature: 300 deg F.

H. Capacities and Characteristics:
   1. Maximum Heat Output: 12 W/ft.
   2. Piping Diameter: As shown on Drawings.
   3. Volts: 120 V.

2.2 CONTROLS

A. Remote bulb unit with adjustable temperature range from 30 to 50 deg F, set at 38 deg F.

B. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

C. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.

D. Corrosion-resistant, waterproof control enclosure.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Division 23 Section "Identification for HVAC Piping and Equipment."

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.

B. Install electric heating cables after piping has been tested and before insulation is installed.

C. Install electric heating cables according to IEEE 515.1.

D. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."

E. Install warning tape on piping insulation where piping is equipped with electric heating cables.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Protect installed heating cables, including nonheating leads, from damage.

H. Ground equipment and connect wiring according to Division 26 Sections.

I. Heat tracing to be hard-wired to junction box; coordinate with Division 26.

3.2 FIELD QUALITY CONTROL

A. Testing: Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

1. Test cables for electrical continuity and insulation integrity before energizing.
2. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounting cables.

C. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 230533

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

A. Product Data: For all products provided.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the NC Building Code / IBC unless requirements in this Section are more stringent.

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

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Delegated Design Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

G. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling.

Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   5. Test to 90 percent of rated proof load of device.
   6. Measure isolator restraint clearance.
   7. Measure isolator deflection.
   8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.
D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical painting and identification.

1.2 SUBMITTAL

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

B. Note: Contractor to coordinate with owner to incorporate owners' internal standard coloring schemes (for labeling of all equipment, ductwork, piping, controls, etc.) into project. This shall be done prior to submittals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the area served.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Stenciled pipe labels: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.
3. Stenciling / Labeling and directional flow arrows to be located every 10 feet and immediately before and after floor / wall penetrations.
4. Provide metal valve tags (with number) for each valve in piping (shutoff valves, check valves, control valves, etc.). Contractor to provide laminated valve-tag list in each mechanical room (on wall) and in final O&M manuals. List to include number, type, manufacturer, service, size, etc. (all information necessary for reordering). Valve numbering scheme to be per good practice. Valve tags to be by Seaton or approved equal and be brass construction (secure to each valve with chain or other approved method).

2.3 DUCT LABELS

A. Stenciled painted labels.

B. Letter Color: Black.

C. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.
3. Stenciling / Labeling and directional flow arrows to be located every 10 feet and immediately before and after floor / wall penetrations.

2.4 STENCILLED PAINTED LABELS

A. Material: Spray paint suitable for application on piping, ducts, and equipment, both insulated and uninsulated.
B. Letter color: Black or other color contrasting with background surface.
C. Minimum Label Size: Length and width vary for required label content.
D. Minimum Letter Size: At least 1-1/2 inches high.
E. Contents: As described in this section for piping, ducts, and equipment.

2.5 CEILILNG IDENTIFICATION

A. Color tape labels, ½" height, affixed to ceiling grid.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.3 PIPE IDENTIFICATION

A. All exposed piping shall be painted and identified with stenciling every 10 feet.
B. Piping in concealed spaces (above ceilings etc.) must only be stenciled.
C. Also stencil at every transition, wall penetration and at every branch.
D. Identification and lettering shall be oriented to be easily observable from normal viewing locations.
E. Pipe Identification Schedule:

Pipe	Coloring Scheme	ICI
Gas	Safety yellow / Black arrows & letters	
HVAC Hot Water Supply	Orange / White arrows & letters	Orange 70 YR 30 / 651
HVAC Hot Water Return	Orange / Black arrows & letters	Orange 70 YR 30 / 651
Chilled Water Supply	Dark blue / white arrows & letters	Phantom Blue 72 BB 07 / 288
Chilled Water Return	Dark blue / black arrows & letters	Phantom Blue 72 BB 07 / 288
Condenser Water Supply	Light blue / white arrows & letters	Blue Flame 90 BG 57 / 180
Condenser Water Return	Light blue / black arrows & letters	Blue Flame 90 BG 57 / 180

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive or stenciled painted labels on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
   5. Stenciling / Labeling and directional flow arrows to be located every 10 feet and immediately before and after floor / wall penetrations.

3.5 LOCATING MARKERS ON CEILINGS

Coordinate with owner to provide a tape label (or adhesive-back, coded dot – as approved / allowed by owner) identification scheme for suspended ceilings to identify above ceiling equipment.

A. Heating Hot Water: Provide ½" color tape labels (or adhesive-back, coded dot – as approved / allowed by owner) on grid ceiling to identify Hot Water System components as indicated.

Hot Water System	Orange Background with Lettering
Pipe Drain	DR
Pipe Vent	V
Control Valve	CV
Balancing Valve	BV
VAV Box	VAV
Unit Heater	UH
Shutoff Valve	SHTV

B. Chilled Water: Provide ½" color tape labels (or adhesive-back, coded dot – as approved / allowed by owner) on grid ceiling to identify Chilled Water System components as indicated.

Chilled Water System	Dark Blue Background with Lettering
Pipe Drain	DR
Pipe Vent	V
Control Valve	CV
Balancing Valve	BV
Shutoff Valve	SHTV

C. Other Systems: Provide ½" color tape labels (or adhesive-back, coded dot – as approved / allowed by owner)on grid ceiling to identify Other Systems as follows:

System	Color / Lettering
Balancing Dampers	Dark Blue / BD
Unit Heaters	Orange / UH
Fire Dampers	Red / FD
Sanitary Sewer	Dayglo green / CL
Natural Gas	Yellow / SO

END OF SECTION 230553

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

During Test and Balance, the Mechanical Contractor, the Controls Sub-Contractor / Owner, and the Test and Balance Agency shall be on site, together, at all times. M.C., Controls Sub. / Owner Operators, Jabil Validations, and T&B Contractor to coordinate a mutually agreeable schedule, such that this occurs.

Test and Balance Scope of Work:

1. **Provide full "final" test and balance for all hvac equipment affected by or added by this project (air and water-side) at the end of the project (in all possible "modes of operation" – see sequences of operation and coordinate with existing conditions).**
2. **Provide miscellaneous / minor test and balance (adjusting) in areas served by hvac equipment affected by the project as required during the warranty period to meet owner's needs (comfort and functionality).**
3. **Furnish final balancing adjustments in order to maintain pressure cascade and prescribed differentials, as required.**

PART 1 - GENERAL

1.1

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume (VAV) systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
      b. Variable flow systems.
   3. HVAC and other equipment quantitative-performance settings, including boilers, water heaters, air handling units, DX units, heat pumps, pumps, hoods, fans, etc.
   4. Kitchen hood airflow balancing.
   5. Lab Exhaust
   6. Verifying that automatic control devices are functioning properly.
   7. Reporting results of activities and procedures specified in this Section.

1.3 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project. Test and Balance Contractor shall be "independent", contracted separately by the Construction Manager (i.e. T&B work is not in this contractor, however, support from other contractors and sub-contractors to support work of T&B contractor is in this contract).

B. Daily Field Data reports: During testing and balancing operations, submit actual field data reports to Engineer daily via fax or email. Daily reports should include actual readings taken and any problems encountered during that day.

C. Certified TAB Reports: Submit four copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

D. Warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems " or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

1.5 PROJECT CONDITIONS

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

B. TAB will be conducted under the Mechanical Contractor. Refer to Project HVAC Specifications and Drawings for requirements of General Contractor/HVAC Contractor to support TAB operations. *TAB to be contracted by the mechanical contractor.*

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities. Coordinate with the M.C.'s TAB contractor.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

C. **Convene and conduct a TAB coordination meeting, no more than two weeks prior to starting TAB activities on site. Attendees shall include Owner's representative, Engineer, General Contractor, HVAC subcontractor, controls installer, and any others necessary to support TAB activities. Agenda shall include: schedule for TAB activities, support and coordination required, status of deficiencies noted in TAB inspections specified in this Section, and any other items necessary to complete testing and balancing in accordance with this section.**

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

C. Adjustments: For one year after Owner occupancy, provide the services of a qualified TAB technician upon request of the Designer to take readings and make adjustments as necessary and directed by Designer for comfort conditions.

PART 2 - PRODUCTS/VENDORS

2.1 ACCEPTABLE TAB CONTRACTORS

A. The following TAB agents are acceptable to Owner and Designer for providing TAB services:

1. Palmetto Air and Water Balance, Inc. (Asheville, Charlotte, Raleigh NC and Greenville, SC)
2. Watts Services (Morganton, NC)
3. Hall Technology, Inc. (Leesville, SC)
4. Test and Balance Corporation (Winston-Salem, NC)
5. The Phoenix Agency (Winston-Salem, NC)
6. Mullinax Test and Balance (Gaffney, SC)

B. The Designer will consider other TAB agents as acceptable under the following conditions:

1. Request to consider another TAB agent is received.
2. Request to consider another TAB agent is submitted at least 10 days prior to receipt of bids.
3. Proposed TAB agent is certified per this specification.

4. Approval for a proposed TAB agent to bid the project will be communicated via Addendum prior to receipt of bids.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
B. Examine approved submittal data of HVAC systems and equipment.
C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."
D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
G. Examine system and equipment test reports.
H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
M. Examine strainers for clean screens and proper perforations.
N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
P. Examine system pumps to ensure absence of entrained air in the suction piping.
Q. Examine equipment for installation and for properly operating safety interlocks and controls.
R. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to indicated values.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, water treatment conducted, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.
9. Systems and equipment are labeled per Project Specifications.

3.3 INSPECTIONS DURING CONSTRUCTION/INSTALLATION

A. SIXTY PERCENT DUCTWORK INSPECTION

1. Notify Designer of inspection schedule at least one week prior to inspection.
2. Inspect installation of HVAC systems when sixty percent of ductwork is installed.
3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.

B. NINETY PERCENT SYSTEM INSPECTION

1. Notify Designer of inspection schedule at least one week prior to inspection.
2. Inspect installation of HVAC systems when ninety percent of HVAC system is installed.
3. Verify general installation of HVAC system, including piping, ducts, valves, dampers, control devices, etc.
4. Verify access to control and balancing devices, including installation of access doors, panels, etc.
5. Report deficiencies in writing within one week of inspection to HVAC contractor, general contractor, and Designer.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. During TAB operations, submit field data to Engineer daily via fax or email. List systems/equipment tested, problems encountered, and deficiencies noted.

E. Witness start-up and tests for all major HVAC equipment. Include copies of test reports, including manufacturer's start-up check lists included in manufacturer's installation instructions, in the Test-and-Balance report.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.
D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
G. Verify that motor starters are equipped with properly sized thermal protection.
H. Check dampers for proper position to achieve desired airflow path.
I. Check for airflow blockages.
J. Check condensate drains for proper connections, trap depth, and functioning.
K. Check for proper sealing of air-handling unit components.
L. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
    1. Measure fan static pressures to determine actual static pressure as follows:
        a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
        b. Measure static pressure directly at the fan outlet or through the flexible connection.
        c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
        d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
    2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
        a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
    3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
    4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
    5. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
    6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
    1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
        a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
    2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
C. Measure terminal outlets and inlets without making adjustments.
    1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
    1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
    2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
   2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
   3. Measure total system airflow. Adjust to within indicated airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
   6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
   7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
   8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance systems similar to constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
   7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
      a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
   8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
   2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.
C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.
B. Set calibrated balancing valves, if installed, at calculated presettings.
C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.
F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.
C. Record compressor data.

3.13 PROCEDURES FOR BOILERS, WATER HEATERS, AND OTHER FUEL FIRED EQUIPMENT

A. If hydronic, measure entering- and leaving-water temperatures and water flow.
B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.
C. Record the following data:
   1. Equipment drawing designation;
   2. Equipment manufacturer, model number, and serial number;
   3. Rated input and output;
   4. Type of fuel and heat value (calorific value);
   5. Other data from the nameplate of the equipment.
D. Record the following measurements:
   1. Percent carbon dioxide
   2. Stack temperature (flue gas temperature at equipment outlet)
   3. Ambient temperature
   4. Over-fire draft (inches WG)
   5. Gas burner manifold pressure
   6. Fuel meter reading (see below)
   7. Boiler jacket temperature
E. Fuel meter readings shall be determined as follows:
   1. Natural Gas: The objective of this test is to determine gross MBH input.
      a. Time the gas meter under each firing rate to determine the CFH (cubic feet per hour) delivered. CFH shall be calculated by the equation: CFH equals U value of timing dial for one rotation times 36,000 divided by time in seconds for one rotation of timing dial.
      b. Measure or determine the gas pressure at the gas meter and apply the proper correction factor to the delivered CFH that was measured to determine the equivalent CFH at the rated gas pressure. This shall be determined by the following equations:

$$F = (UPa + PgO)/(Pa + Pr)$$

Where F = Correction Factor; Pa = Atmospheric pressure (psi); Pg = Gas pressure at meter (psi); Pr = Rated gas pressure And Rated CFH = Measured CFH x Correction Factor

   2. Oil Fired: The oil pressure at the pump shall be measured and recorded. Oil flow rate shall be determined from manufacturer's data and nozzles installed.
   3. LP Gas Fired: The burner manifold pressure shall be measured and pressure read at tank, before and after each regulator under system full load conditioning for all gas fired

equipment simultaneously. Gas flow rate shall be determined using manufacturers data as applicable.

F. If burners have other than one firing rate, combustion tests shall be made in the following manner:
   1. If step-firing (High-Low), readings shall be taken at each step.
   2. If modulating, reading shall be taken at high, at low, and at 50 percent firing rate.

G. The following calculations shall be made from the measured data and recorded on the report:
   1. Gross Input
   2. Net Stack Temperature
   3. Percent Excess Air
   4. Percent Flue Gas Loss
   5. Combustion Efficiency
   6. Gross Output (MBH) = Gross Input - Flue Gas Loss

H. Flue gas loss shall be calculated from measured data using industry accepted methods.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.
   8. For coils with 3-way control valves, adjust bypass ball valve so that flow in bypass mode is the same as flow through the coil.

B. Electric-Heating Coils: Measure the following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.
   5. Refrigerant suction pressure and temperature.

3.15 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.16 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.17 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.
4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.18 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.
C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
a. Settings for outside-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.
E. System Diagrams: Include a copy of the design drawings, marked to note as-built/as-installed conditions, indicating the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

6. Balancing stations.
7. Location and position of balancing devices.
8. Actual airflows measured at each grille/diffuser.
9. Inlet and outlet static pressures measured at each air handling unit.
10. Pump inlet and outlet pressures and flow rates.
11. Identification on system diagrams to be cross-referenced to tabulated data.

3.19 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

C. Opposite season testing: Perform additional testing, inspecting, and adjusting during the opposite season in which initial TAB procedures were performed.

D. In all cases, notify Designer in advance of performing additional tests.

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment.

1.2 SUBMITTALS

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

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Materials or accessories containing asbestos will not be accepted.

B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

1. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

2.2 INSULATION AND JACKETS

A. Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller, Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex or approved equal.

B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

2.3 FLEXIBLE FIBERGLASS INSULATION:

A. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.

B. Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.4 RIGID FIBERGLASS INSULATION:

A. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

B. Piping: White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

C. Ductwork: Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.5 SEMI-RIGID FIBERGLASS INSULATION:

A. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

B. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.6 CALCIUM SILICATE INSULATION:

A. Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service range of 0 degrees F to 1,200 degrees F,. Material to be visually coded or marked to indicate it is asbestos free.

2.7 ELASTOMERIC INSULATION:

A. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

2.8 POLYOLEFIN INSULATION:

A. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

2.9 PHENOLIC INSULATION:

A. Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.13 at 75 degrees F, minimum compressive strength of 31 psi parrallel and 18 psi perpendicular, maximum water vapor permeability 0.117 perm inch, maximum water absorption of .5% by volume, rated for service range of -290 degrees F to 250 degrees F.

B. Kraft reinforced foil vapor barrier laminate all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

2.10 EXTRUDED POLYSTYRENE INSULATION:

A. Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.285 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of .5 % by volume, rated for service range of -290 degrees F to 165 degrees F.

2.11 POLYISOCYANURATE INSULATION:

A. Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 25 psi parallel and 24 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by volume, rated for service range of -290 degrees F to 300 degrees F.

2.12 CELLULAR GLASS INSULATION:

A. Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.

2.13 MINERAL WOOL INSULATION:

A. Rigid preformed mineral fiber, minimum nominal density of 8 lbs. per cu. ft., thermal conductivity of not more than 0.29 at 200 degrees F, minimum compressive strength of 3 psi, maximum wicking of 1%, maximum water adsorption of 1% by volume, rated for service of -120 degrees F to 1200 degrees F.

2.14 FIREPROOFING INSULATION:

A. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 25, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F, rated for service of -120 degrees F to 1200 degrees F. Use rigid or semi-rigid board for duct insulations.

B. Foil-scrim-polyethylene vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms.

2.15 PVC FITTING COVERS AND JACKETS:

A. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02” indoors/.03”outdoors for piping 12” and smaller, .03” indoors/.04” outdoors for piping 15” and larger.

2.16 METAL JACKETS:

A. .016 inch thick aluminum or .010 inch thick stainless steel with safety edge.

2.17 SELF-ADHERING JACKETS:

A. Self-adhering waterproofing membrane consisting of laminated reflective high density aluminum foil, high density waterproof polymer films and 40 mil rubberized adhesive asphalt waterproofing compound with release paper .

2.18 INSULATION INSERTS AND PIPE SHIELDS:

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products

B. Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to preengineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.

D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2" and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to preengineered/premanufactured product described above.

E. Wood blocks will not be accepted.

2.19 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.

D. Tack fasteners to be stainless steel ring grooved shank tacks.

E. Staples to be clinch style.

F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement to be ASTM C449.

H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.

I. Bedding compounds to be non-shrinking and permanently flexible.

J. Vapor barrier coatings and tapes to have maximum applied water vapor permeance of .05 perms.

K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.

B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.

C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

F. Insulation shall be continuous through sleeves and openings except where fire rated penetration materials require interruption of insulation. Vapor barriers shall be maintained continuous through all penetrations.

G. Provide a complete vapor barrier for insulation on the following systems:
   1. Cold Water Make-Up
   2. Chilled Water
   3. Refrigerant
   4. Glycol/Brine
   5. Insulated Duct
   6. Equipment or piping with a surface temperature below 65 degrees F

3.2 PIPE INSULATION:

A. General:
   1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples,

longitudinal and transverse seams with vapor barrier mastic on systems requiring vapor barrier.

2. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
3. Fully insulate all reheat coil piping, fittings and valves (with the exeption of unions) up to coil connection to prevent condensation when coil is inactive during cooling season.

B. Insulation Inserts and Pipe Shields: Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

C. Fittings and Valves: Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic over ends, throat, seams and penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

D. Mineral Fiber: Secure each 3' section with three stainless steel bands or five 16 gauge stainless steel or annealed copper tie wires evenly spaced and at ends. Twist wire ends, snip off excess and turn ends over into insulation. Stagger joints where more than one layer is used.

E. Elastomeric and Polyolefin: Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyeolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40 degrees F with vapor barrier mastic.

F. EXTRUDED POLYSTYRENE AND POLYISOCYANURATE: Secure insulation sections with two wraps of nylon filament tape 9"-12" on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of elastomeric joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. For piping service below 0^{o}F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Fill voids in factory molded or built-up valve and fitting insulation with foamed in place urethane insulation. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6" from pipe. Cover insulation with a protective covering of 2 coats of vapor barrier mastic with fabric reinforcing. Do not penetrate protective covering or insulation with mechanical fasteners.

G. PROTECTIVE JACKETS

1. Provide a protective metal jacket for the following insulated piping: All outdoor exposed mechanical (condenser water, chilled water, makeup water, etc.) piping – where exposed to weather and / or moisture. Jacketing to be flashed, counter-flashed, and sealed weather-tight._____
2. Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet-metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications.
3. Provide a protective covering of 2 coats of vapor barrier mastic with fibrous glass or canvas fabric reinforcing or (at contractor's option) - metal jacket (as described above) for the following insulated piping: All indoor exposed mechanical piping (condenser water, chilled water, hot water, etc..) in mechanical equipment rooms or where subject to damage._____
4. Provide an integral factory applied jacket (such as ASJ) for the following insulated piping: All concealed mechanical piping (condenser water, chilled water, hot water, etc..) – where concealed above ceilings and not subject to damage.
5. Install only when ambient temperature is 60 degrees F or above. Thoroughly clean and dry surfaces. Cut allowing minimum 4" overlap on ends and 6" on longitudinal joints. Align parallel to surface. Remove release paper and press in place. Rub

entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.

H. PIPE INSULATION SCHEDULE:

1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service Types	Insulation	Insulation Thickness by Pipe Size				
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"	5" to 6"	8" and larger
Hot Water Heating	Rigid Fiberglass	1.5"	2"	2"	2"	2"
Chilled Water Piping	Elastomeric / Rigid Fiberglass	1.5"	1.5"	1.5"	1.5"	1.5"
Condenser Piping	Rigid Fiberglass	1"	1.5"	1.5"	1.5"	1.5"
Refrigerant Suction						
>40°F	Elastomeric/Polyol	0.5"	1"	1"	1"	1"
40°F to 20°F	Elastomeric/Polyol	1"	1.5"	1.5"	1.5"	1.5"
20°F to -20°F	Ext Poly/Polyiso	1.5"	2"	2"	2"	2.5"
-20°F to -60°F	Ext Poly/Polyiso	2"	2"	2.5"	2.5"	3"
Cold Water Piping	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Cool. Coil Condensate	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Remote Generator Radiator Piping	Rigid Fiberglass	1.5"	1.5"	2"	2"	2"

2. The following piping and fittings are not to be insulated:
   a. Hot water piping inside radiation, convector, or cabinet heater enclosures
   b. Piping unions for systems not requiring a vapor barrier

Note: All work exterior to building and below grade shall have: 1" foamglass (K.40/inch) wrapped in 45# roofing felt, with end joints and longitudinal seams lapped at least 2", tied on with copper wire at 8" o.c. minimum, and thoroughly sealed with Foster #60-25 sealer, for trowel application. Underground piping and insulation shall be supported on blocking in trench until sand bedding and encasement is placed in accordance with details shown on plans.

All work exterior to building shall be jacketed with 0.016: aluminum corrugated metal jacket with moisture barrier, Childers #1100 or equal. Side and end laps shall be at least 2 inches wide and cut edge of side lap shall be turned under one inch to provide a smooth edge. Laps shall be placed to shed water. Jackets shall be secured in place with 1/2" stainless steel bands on 9 inch centers and wing seals. Place preformed 2" butt strap with sealant over seam. Fittings shall be similarly jacketed utilizing Childers accessories and covers. All exterior work shall be completely weather-sealed. All exterior piping shall be heat-traced. Heat trace wattage and control to be as suggested by Chromalox (or approved equal), based on job-specific conditions. Heat trace type to generally be parallel, self-regulating type, 277V-1ph., complete with controls and all connection accessories as required for a complete installation. Furnish sizing parameters, suggested control, product information, etc. with submittal package – for review and approval by the engineer. Furnish all accessories as required and recommended by the manufacturer. Submittal to include general accessories being provided (such as: power connection kits, splice and tee kits, end seal kits, heat trace controllers/panel(s), etc.) Include all power wiring, devices, fastening/clamps, conduits, etc. As required for a complete installation. Install complete per manufacturers' installation instructions.

Heat trace wattage to be 5 W/ft (minimum), however, contractor to assure/verify with manufacturer, prior to ordering, that the wattage that is being recommended / submitted is sufficient, as recommended by the manufacturer, with the pipe insulation utilized, specific job site conditions, etc. to protect piping from freezing down to -10 deg. F ambient temperature. Coordinate with insulation being furnished. Heat trace controllers/panels(s) (indicator lights) shall be mounted together in an accessible location – such as on mech. Platform indoors (per owner's request).

3.3 DUCT INSULATION

A. General:

1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins or speed clips. Space fasteners 18" on center or less as required to prevent sagging for flexible duct insulation. Space fasteners not

less than 3” from edge or corner and 12” on center or less for rigid duct insulation. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4” tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed.

2. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
3. External supply duct insulation is not required where ductwork contains continuous 1” acoustical liner. Provide 4” overlap of external insulation over ends of acoustically lined sections.

B. Protective Coverings:
1. Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with fibrous glass or canvas fabric covering for the following ductwork: All exposed ductwork in mechanical equipment rooms or where subject to damage._____
2. Provide a protective covering of galvanized or factory painted steel panels with gasket and caulked joints and seams for the following ductwork: All exterior ductwork subject to weather and / or moisture._____
3. Provide an integral factory applied jacket (such as FSK jacket) for the following insulated ductwork: All concealed ductwork above ceiling that is not subject to damage._____
4. Install only when ambient temperature is 60 degrees F or above. Thoroughly clean and dry surfaces. Cut allowing minimum 4” overlap on ends and 6” on longitudinal joints. Align parallel to surface. Remove release paper and press in place. Rub entire surface for full adhesion and sealing at joint overlaps. Provide a bead of compatible caulk along exposed edges.

C. Breeching: Fasten insulation over weld pins and secure with washers. Space fasteners not less than 3” from edge or corner and 12" on center longitudinally and 9" on center in the transverse direction. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4” tape of same material as jacket. Seal tape with plastic applicator and secure with staples.

D. GREASE DUCTS: Strictly adhere to manufacturer’s installation instructions and rating requirements for application of fire-stop insulation. Cover all exhaust ducts serving Type I kitchen hoods with fire-stop insulation from a point prior to penetration of ceiling, wall, floor or concealment through building to termination at outside of building. Extend fire-stop insulation through roof curbs.

E. Duct Insulation Schedule:
1. Provide duct insulation on new and existing remodeled ductwork in the following schedule:

Service	**Insulation Type**	**Insulation Thickness**
Outside air ducts	Rigid Fiberglass	2"
Mixed air ducts	Rigid Fiberglass	2"
Exposed supply ducts	Rigid Fiberglass	2"
Exposed return ducts	Rigid Fiberglass	2"
Exposed outside air ducts	Rigid Fiberglass	2"
Concealed supply ducts	Flexible Fiberglass	1-1/2"
Concealed return ducts	Flexible Fiberglass	1-1/2"
Concealed outside air ducts	Flexible Fiberglass	1-1/2"
Exhaust and relief ducts downstream of motorized backdraft dampers	Rigid Fiberglass	2"
All ducts exposed to weather	Rigid Fiberglass	3"

* Exposed Ductwork (i.e. within the building envelope (through occupied spaces) or within the building but outside the envelope). Indoor exposed ductwork to be jacketed / finished as required (i.e. insulation shall not be exposed unless elastomeric)
* Outdoor (exposed to weather) ductwork to be jacketed and weather/water-proofed (regardless of insulation type). Outdoor ductwork to be insulated with 3” Armaflex wrap (or equivalent) and covered with childers jacketing – flashed, counter-flashed, and sealed to prevent leaks.

EQUIPMENT INSULATION

F. GENERAL: Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

G. Semi-Rigid Fiberglass: Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. Use vapor barrier mastic on systems requiring a vapor barrier.

H. Elastomeric/Polyolefin: Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

I. REMOVABLE COVERS: Provide insulated easily removable galvanized steel metal boxes for routine service access on the following equipment: _Pumps, outdoor control valves, where removable elastomeric is not practical._____

J. Provide insulated easily removable elastomeric insulation sections for the following equipment: where practical – furnish removable covers where not.

K. Equipment Insulation Schedule: Provide equipment insulation as follows:

Equipment	**Insulation**	**Thickness Type**
Reheat coil casing in exposed supply ducts	Elast. / Rigid Fiberglass	3"
Reheat coil casing in concealed supply ducts	Elast. / Flexible Fiberglass	2"
Preheat coil casing in return ducts	Elast. / Flexible Fiberglass	2"
Air separators	Elast. / Semi-Rigid Fiberglass	2"
Chilled water compression tanks	Elast. / Semi-Rigid Fiberglass	2"
Heat exchangers	Semi-Rigid Fiberglass	2"
Hot Water Storage tanks	Semi-Rigid Fiberglass	2"
Chilled Water Pumps	Elastomeric/Polyolefin	2"
Hot Water Pumps	Elastomeric/Polyolefin	2"
Air Handling Unit Casings or attached component sections not factory insulated	Elast. / Rigid Fiberglass	2”

* Insulate air handling unit casings, chambers, or plenums (filters, mixing chambers, sound attenuators, etc.) in accordance with requirements of adjacent duct insulation.

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC
PART 1 GENERAL

GENERAL - SCOPE OF WORK

This project to include chiller unit program control (at the "local" level) via factory packged controls / controller (with bacnet capability or bacnet card) hardware – for full integration to the building energy management system by others in the future (not in this contract). Programming to be provided complete, by this contractor (factory packaged / programmed). Existing "Local" level controls / EMS shall remain in service.
Mechanical contractor / unit supplier to furnish factory packaged controls.
Chiller to have factory installed / programmed controls – furnished complete by the manufacturer, with BACNET cards / interface and capability for full integration to the building ems by the controls contractor at a later date (not in this contract). Integration to involve all available points for a complete system for full monitoring, adjustment of setpoints and limits, trending, alarming, notification, etc. – including full graphics (built on the building ems).

A. The Controls Subcontractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. Complete temperature control system as specified herein. Controls subcontractor must have provided satisfactory service in the local area for past five years. System offered as substitute for those used for design shall have suitable performance and final approval will be reserved, pending satisfactory performance on the job.

B. This project shall be accessible from Owner's new workstation at maintenance office, and via laptop computer(s), and graphic displays for this project shall be accessible at the workstations. Contractor shall supply new PC hardware and graphics software (as required) under this project should new version(s) of software be required, and / or should hardware required subsequent updating; although, the intent is to utilize existing for standardization. Contractor to furnish all interface modules and equipment and accessories as required to interface with Baxter System Ethernet, WAN or LAN as required. System shall include password protection, with at least three distinct levels of access (i.e. Viewing Only, Engineer Level, Administrator Level (Full Access)).

C. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

D. Controls subcontractor shall be responsible for all Building Automation System (BAS) and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with electrical specifications, all local and national codes. Low voltage class 2 wiring may be run without conduit above suspended ceilings, provided it is neatly run parallel to building lines and adequately secured to

building structure. All electrical signal wiring together with all field control wiring whether a part of the automation system or not shall be provided for all equipment in the mechanical section as a part of the work of this section.

E. The system shall be complete in all respects including all labor, materials, equipment and services necessary, and shall be installed by personnel regularly employed by the manufacturer and engaged in this type of work. The system shall include all appurtenances whether or not specifically implied or expressed herein or on the contract drawings.

F. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 100 miles of the site with a trained staff, spare parts inventory and necessary test and diagnostics equipment. Baxter requires same-day response for all service calls.

G. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

H. BAS shall comply with UL 916 PAZX and 864 UDTZ, and other subsystem listings as applicable, and herein specified, and be so listed at the time of bid.

I. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

J. Any controls devices shall be located for convenient access and function if not specifically located on drawings, including all conduit and wiring required to be furnished and installed by this contractor. All thermostat and operable controls devices shall be located not higher than 48" AFF.

K. All thermostats and/or sensors shall be matching in appearance, i.e., night sensor, night zone, thermostat, etc., shall match normal thermostat utilized in that zone for control.

L. Provide surge suppression protection for all components and power sources. Provide all power wiring for all controls from power source(s) shown or provided for mechanical equipment. ***Provide battery back-up / UPS systems as required for all control equipment / components / hardware as required to prevent loss of controls.***

M. Label all controls, relays, switches, terminals points, adjustments, thermostats, etc., with approved plastic nameplates, attached securely.

N. The control manufacturer shall thoroughly check and calibrate the control system and place it in working order as specified and to the Engineer's satisfaction. The contractor shall include in his contract complete instructions and necessary control

data to the maintenance personnel on the installed control system. The control manufacturer shall then certify in letter form to the Engineer and Architect that all control requirements have been met and that all control components are calibrated and in working operation as specified and names of Owner's personnel instructed.

All control settings shall be appropriately marked inconspicuously beside dampers, knobs, and adjustments, permanently. All relays to visually indicate energized/de-energized position or contain integral pilots. Post at each panel up-to-date, as installed, reduced control drawings; see previous section of specifications concerning instruction and parts manuals, warranties, service, etc.

P. All controls to be adjustable and exact setpoints determined and adjusted in building conditions in field, to include any reprogramming or adjustment needed during warranty/service period specified.

Q. Verify the accuracy of the final settings and operation of control sequence in automatic operation by recording space temperature in a typical conditioned space for each separately controlled zone for a minimum of 48 hours of system automatic operation, and transmit chart recordings to the Engineer within 24 hours of completion. EMS system trend logs will be acceptable for this.

After checkout and calibration, provide a 30-day temperature recording of each system's main space, with system operating in fully automatic mode. Again EMS system trend logs will be acceptable.

Controls manufacturer shall include in the contract price an allowance for 5% spare points of each type, wired to controlled devices, including input devices as required to allow for unexpected conditions which may occur during construction.

Controls system shall include battery backup system(s) as required (local battery UPS systems or similar) to provide power carryover between power off, and generator start for all control components so that all systems continue to function without resetting, going into failure mode, etc.. EMS controls system to be fully functional thru power blips, or extended power outages. In addition, all EMS components shall be directly or indirectly (via transformers as required) powered from emergency (generator) power source(s) on site where available and as required. Coordinate requirements with the Electrical Sub-Contractor.

PART 1 GENERAL

Note: All controls shall be factory furnished / packaged and factory or field programmed by the manufacturer (equipment supplier) –chillers. All controls / controllers to be factory packaged to the fullest extent possible. All controls, devices, programming, etc. required and / or shown or described, shall be furnished, installed, and programmed by the controls subcontractor as required, if not part of a factory packaged system. All factory packaged controls shall be BACNET compatible and shall be fully integrated by the controls sub-contractor (at a later date – not in this contract). All factory packaged “points” shall include full graphics screens, display, accessibility, etc. via the building ems (include all adjustable setpoints, status indica-

tion, alarms, inputs, outputs, etc. as required).

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 GENERAL

A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.

D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.4 WIRING

A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.

B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

C. Excess wire shall not be looped or coiled in the controller cabinet.

D. Incorporate electrical noise suppression techniques in relay control circuits.

E. There shall be no drilling on the controller cabinet after the controls are mounted inside.

F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

G. Use manufacturer-specified wire for all network connections.

H. Use approved optical isolation and lightning protection when penetrating building envelope.

I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 ACCEPTANCE TESTING

A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR TRAINING

A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. The Control System Contractor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.7 WARRANTY PERIOD SERVICES

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.

C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 5 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.

D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.

E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.8 WARRANTY ACCESS

A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:

1. As-built control drawings for all equipment.
2. As-built Network Communications Diagram.
3. General description and specifications for all components.
4. Completed Performance Verification sheets.
5. Completed Controller Checkout/Calibration Sheets.

3.10 PROTECTION

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

1.1 Sequences

See Drawings

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control sequences for HVAC systems, subsystems, and equipment.

B. See Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

SEQUENCE OF OPERATION:

A. Chilled Water System (Field Controls)

The chilled water system consists of one new / replacement chiller, with existing primary chilled water system pump and a chiller injection pump (new / replacement). The new replacement chiller will be controlled via integral factory controller, except that the system shall be energized / start and stopped via existing energy management system input. The system pumps, etc. will be DDC controlled via existing building controls system. The system shall operate similar to, but not necessarily the exact same as follows:

The chilled water supply setpoint o maintain a constant chilled supply water temperature of 42 deg F (adjustable) at all times. The chilled water system shall operate in the chiller mode to maintain the loop temperature at all times. The secondary (building) chilled water pump(s) shall start. The DDC system will utilize current switches to confirm the pumps are in the desired state (i.e. on or off) and generate an alarm if status deviates from DDC start/stop control. Pumps to have 20 minute time delay off. Any time outside temperature is below 28F (adjustable) injection (primary) pumps and secondary chilled water pump(s) will operate for freeze protection. Note: chiller integral control discharge setpoint to be set at 41 deg. F.

Pumps shall be monitored by an alarm point to the BAS.

After flow has been proven in the chiller loop, the chiller shall be enabled to operate under it's own operating and safety controls. Chillers to stage up and de-stage based on loading.

The chiller injection pump shall operate whenever its chiller is commanded to operate with pump start up in advance of chiller to establish flow prior to chiller starting.

The chilled water system shall be operated on a time-of-day schedule through the BAS, however, at this time – the system shall operate in chiller mode to maintain loop setpoint at all times. System shall be capable of setback / scheduling if required or desired by the owner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Hot-water heating piping.
   2. Chilled-water piping.
   3. Condenser-water piping.
   4. Makeup-water piping.
   5. Condensate-drain piping.
   6. Blowdown-drain piping.
   7. Air-vent piping.
   8. Safety-valve-inlet and -outlet piping.

B. See Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

2.2 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Hot-Water Heating Piping: 125 psig at 200 deg F.
   2. Chilled-Water Piping: 125 psig at 200 deg F.
   3. Condenser-Water Piping: 125 psig at 150 deg F.
   4. Makeup-Water Piping: 80 psig at 150 deg F.
   5. Condensate-Drain Piping: 150 deg F.
   6. Blowdown-Drain Piping: 200 deg F.
   7. Air-Vent Piping: 200 deg F.
   8. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

3.2 SUBMITTALS

A. Product Data: For each type of the following:
   1. Plastic pipe and fittings with solvent cement.
   2. Pressure-seal fittings.
   3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   4. Air control devices.
   5. Chemical treatment.
   6. Hydronic specialties.

B. Field quality-control test reports.

C. Operation and maintenance data.

3.3 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PRODUCTS

4.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

A. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

A. DWV Copper Tubing: ASTM B 306, Type DWV.

B. Wrought-Copper Fittings: ASME B16.22.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. S. P. Fittings; a division of Star Pipe Products.
      c. Victaulic Company of America.
   1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   2. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting

grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

B. Wrought-Copper Unions: ASME B16.22.

8.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

A. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

A. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

10.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

11.2 DIELECTRIC FITTINGS

A. Dielectric unions shall not be used. Instead, utilize full-port brass ball valves with Teflon seats.

11.3 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

11.4 AIR CONTROL DEVICES

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

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

B. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.

C. In-Line Air Separators:
1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg F.

13.2 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Refer to Division 23 Section “HVAC Water Treatment.”

14.2 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

A. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

B. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

EXECUTION

15.2 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed or pressure-seal joints.

A. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

A. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed or pressure-seal joints.

A. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

A. Condenser-water piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed or pressure-seal joints.

A. Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

A. Makeup-water piping installed aboveground shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Air-Vent Piping:
1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints. Include isolation ball valve, downturn fitting (u-bend), hose bib connection, and pipe to nearest drain (where feasible) – coordinate with plumbing drawings for drain locations.

C. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

31.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, at each floor, and where shown on Drawings.

B. Install throttling-duty valves at each branch connection to return main.

C. Install automatic flow control balancing valves in the return pipe of each heating or cooling terminal, or as shown on Drawings.

D. Install triple duty valves at the pump discharge and elsewhere as shown on drawings or as required to control flow direction (i.e. cooling tower bypass, etc..).

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valve and backflow preventor at all makeup-water connections to regulate system fill pressure and prevent backflow back into domestic water supply.

G. Install manual air vents at all high points in hot water heating and chilled water systems (i.e. in main / branch piping, at coils, in mech. rooms, at coils, etc..)

31.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved by Designer.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, ball valve, and hose connection, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up. Eccentric reducers, when used, shall be properly installed to prevent air entrapment on horizontal runs and at equipment.
O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the center-line of the main pipes on horizontal runs (no branch connections to bottom of main piping). For up-feed risers, connect the branch to the top of the main pipe. Utilize only prefabricated supplied fittings – no field fabricated tee's will be accepted.
P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

31.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
A. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
B. Install the following pipe attachments:
    1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
    2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
    3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
    4. Spring hangers to support vertical runs.
    5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
    6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
A. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
    2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
    3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
    4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
    5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
    6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
    7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
B. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
    1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
    2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
    3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
    6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

C. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

34.2 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
A. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

35.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting. Provide ball valve, downturn (u-tube) fitting, and copper tube with hose bib connection. Terminate copper tube 3’ above floor in utility spaces and above ceiling in finished spaces – route to closest drain where practical / possible.
B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
A. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
B. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
    1. Install tank fittings that are shipped loose.
    2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

36.2 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
B. Install control valves in accessible locations close to connected equipment.
C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required. Install shutoff valves so that control valve can be easily removed without main pumping system shutdown.
D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."
E. Install isolation valves on supply and return piping at each coil.

36.3 CHEMICAL TREATMENT

A. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.

B. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

37.2 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.
7. Owner and / or owner’s representative must be notified a minimum of 24 hours in advance of any pipe pressure testing.

B. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.
3. Separately coupled, horizontally mounted, in-line centrifugal pumps.
4. Separately coupled, vertically mounted, in-line centrifugal pumps.
5. Separately coupled, base-mounted, end-suction centrifugal pumps.
6. Automatic condensate pump units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of pump.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

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

1. Bell and Gossett, a Xylem Brand.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange.

2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

a. Enclosure: Totally enclosed, fan cooled.
b. Enclosure Materials: Cast iron.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Efficiency: Premium efficient.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

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

1. Bell and Gossett, a Xylem Brand.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and flanged connections.
2. Impeller: ASTM B584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

5. Pump Bearings: Permanently lubricated ball bearings or oil lubricated; bronze-journal or thrust type.

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Open, dripproof.
b. Enclosure Materials: Cast iron.
c. Motor Bearings: Permanently lubricated ball bearings.
d. Efficiency: Premium efficient.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. [175-psig (1204-kPa)] pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig (1204-kPa) pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting:

1. Install base-mounted pumps on cast-in-place concrete equipment base(s).
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC."
2. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

3.2 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 23 22 13 "Steam and Condensate Heating Piping" and Section 23 22 16 "Steam and Condensate Heating Piping Specialties."

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Where installing piping adjacent to pump, allow space for service and maintenance.

D. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

E. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

F. Install triple-duty valve on discharge side of pumps.

G. Install suction diffuser and shutoff valve on suction side of pumps.

H. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

I. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

J. Install check valve and gate or ball valve on each condensate pump unit discharge.

K. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 23 21 23

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following HVAC water-treatment systems:
   1. Bypass chemical-feed equipment and controls.
   2. Biocide chemical-feed equipment and controls.
   3. Chemical treatment test equipment.
   4. HVAC water-treatment chemicals.

1.2 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:
   1. pH: Maintain a value within 9.0 to 10.5.
   2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
   3. Boron: Maintain a value within 100 to 200 Insert range ppm.
   4. Chemical Oxygen Demand: Maintain a maximum value of 100 Insert number ppm.
   5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
   6. TDS: Maintain a maximum value of 10 ppm.
   7. Ammonia: Maintain a maximum value of 20 ppm.
   8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
   9. Microbiological Limits:
      a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
      b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
      c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
      d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
      e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.
   10. Polymer Testable: Maintain a minimum value within 10 to 40 Insert range.

D. Passivation for Galvanized Steel: For the first 60 days of operation.
   1. pH: Maintain a value within 7 to 8.
   2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 Insert range ppm.
   3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm.

1.3 SUBMITTALS

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

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Other Informational Submittals:
   1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
   2. Water Analysis: Illustrate water quality available at Project site.
   3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.4 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Basis of Design: Nalco Inc.. Comparable Products: Aqua-Chem, Inc.; GE Betz.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.
   1. Capacity: As shown on Drawings.
   2. Minimum Working Pressure: 175 psig.

2.3 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:
   1. AWWA C700, oscillating-piston, magnetic-drive, totalization meter.
   2. Body: Bronze.
   3. Maximum Pressure Loss at Design Flow: 3 psig.
   4. Registration: Gallons or cubic feet.
   5. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable increments of total flow.

B. Inhibitor Injection Timers:
   1. Microprocessor-based controller with LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
   2. Programmable timers with infinite adjustment over full range, and mounted in cabinet with hand-off-auto switches and status lights.
   3. Test switch.
   4. Hand-off-auto switch for chemical pump.
   5. Illuminated legend to indicate feed when pump is activated.
   6. Programmable lockout timer with indicator light. Lockout timer to deactivate the pump and activate alarm circuits.
   7. LCD makeup totalizer to measure amount of makeup and bleed-off water from two water meter inputs.

C. pH Controller:
   1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 14 units. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
   2. Digital display and touch pad for input.
   3. Sensor probe adaptable to sample stream manifold.
   4. High, low, and normal pH indication.
   5. High or low pH alarm light, trip points field adjustable; with silence switch.
   6. Hand-off-auto switch for acid pump.
   7. Internal adjustable hysteresis or deadband.

D. TDS Controller:
   1. Microprocessor-based controller, 1 percent accuracy in a range from zero to 5000 micromhos. Incorporate solid-state integrated circuits and digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
   2. Digital display and touch pad for input.
   3. Sensor probe adaptable to sample stream manifold.
   4. High, low, and normal conductance indication.

5. High or low conductance alarm light, trip points field adjustable; with silence switch.
6. Hand-off-auto switch for solenoid bleed-off valve.
7. Bleed-off valve activated indication.
8. Internal adjustable hysteresis or deadband.
9. Bleed Valves:
    a. Cooling Systems: Forged-brass body, globe pattern, general-purpose solenoid with continuous-duty coil, or motorized valve.

E. Biocide Feeder Timer:
1. Microprocessor-based controller with digital LCD display in NEMA 250, Type 12 enclosure with gasketed and lockable door. Interface for start/stop and status indication at central workstation as described in Division 23 Section "Instrumentation and Control for HVAC."
2. 24-hour timer with 14-day skip feature to permit activation any hour of day.
3. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
4. Solid-state alternator to enable use of two different formulations.
5. 24-hour display of time of day.
6. 14-day display of day of week.
7. Battery backup so clock is not disturbed by power outages.
8. Hand-off-auto switches for biocide pumps.
9. Biocide A and Biocide B pump running indication.

F. Chemical Solution Tanks:
1. Chemical-resistant reservoirs fabricated from high-density opaque polyethylene with minimum 110 percent containment vessel.
2. Molded cover with recess for mounting pump.
3. Capacity: 50 gal..

G. Chemical Solution Injection Pumps:
1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints.

I. Injection Assembly:
1. Quill: Minimum NPS 1/2 with insertion length sufficient to discharge into at least 25 percent of pipe diameter.
2. Ball Valve: Two-piece, stainless steel; selected to fit quill.
3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.
4. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.4 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.
1. Two-station rack for closed-loop systems.
2. Four-station rack for open systems.

2.5 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Water Softener Chemicals:

1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.
2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.
B. Install water testing equipment on wall near water chemical application equipment.
C. Install interconnecting control wiring for chemical treatment controls and sensors.
D. Mount sensors and injectors in piping circuits.
E. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and chilled water, and equipped with the following:
   1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   2. Install water meter in makeup water supply.
   3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   4. Install a full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
   5. Install a swing check on inlet after the isolation valve.
F. Install automatic chemical-feed equipment for condenser water and include the following:
   1. Install makeup water softener.
   2. Install water meter in makeup water supply.
   3. Install inhibitor injection pumps and solution tanks with injection timer sensing contacts in water meter.
      a. Pumps shall operate for timed interval on contact closure at water meter in makeup water supply connection. Injection pump shall discharge into boiler feedwater tank or feedwater supply connection at boiler.
   4. Install test equipment and provide test-kit to Owner. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
   5. Install TDS controller with sensor and bleed valves.
      a. Bleed valves shall cycle to maintain maximum TDS concentration.
   6. Install pH sensor and controller with injection pumps and solution tanks.
      a. Injector pumps shall operate to maintain required pH.
   7. Install biocide feeder alternating timer with two sets of injection pumps and solution tanks.
      a. Injection pumps shall operate to feed biocide on an alternating basis.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.
C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."
D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."
E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.
F. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.
G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
   2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
   3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
   4. All start-up screens for pumps when pulled shall be presented to the owner / engineer for acknowledgement and displayed at the locatin strainer was pulled from system pumps.
   5. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
   6. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   7. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   8. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
   9. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:
   1. Silica: ASTM D 859.
   2. Acidity and Alkalinity: ASTM D 1067.
   3. Iron: ASTM D 1068.
   4. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Division 23 Section "Demonstration and Training."

END OF SECTION 232500

SECTION 236423 -AIR COOLED WATER CHILLERS

General:

Units are constructed of galvanized steel frame with galvanized steel panels and access doors. Component surfaces are finished with a powder-coated paint. Each unit ships with full operating charges of refrigerant and oil.

Certified AHRI Performance:

Trane air-cooled chillers are rated within the scope of the Air-Conditioning, Heating & Refrigeration Institute (AHRI) Certification Program and display the AHRI Certified® mark as a visual confirmation of conformance to the certification sections of AHRI Standard 550/590 (I-P) and ANSI/AHRI Standard 551/591 (SI). The applications in this catalog specifically excluded from the AHRI certification program are:

• Custom Units

• Units produced outside of the USA for installations outside the USA

• Evaporatively-cooled chillers

• Units with evaporators that use fluid other than fresh water except units containing freeze protection fluids in the condenser or in the evaporator with a leaving chilled fluid temperature above 32°F [0°C] are certified when rated per the Standard with water

Compressor and Motor:

The unit is equipped with two or more hermetic, direct-drive, 3600 rpm 60 Hz (3000 rpm 50 Hz) suction gas-cooled scroll compressors. The simple design has only three major moving parts and a completely enclosed compression chamber which leads to increased efficiency. Overload protection is included. The compressor includes: centrifugal oil pump, oil level sight glass and oil charging valve. Each compressor will have compressor heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

Unit-Mounted Starter:

The control panel is designed per UL 1995. The starter is an across-the-line configuration, factorymounted and fully pre-wired to the compressor motor and control panel. A factory-installed, factory-wired 820 VA control power transformer provides all unit control power (120 Vac secondary) and Trane CH530 module power (24 Vac secondary). Power line connection type is standard with a terminal block.

Evaporator:

Braze plate heat exchanger is made of stainless steel with copper as the braze material. It is designed to withstand a refrigerant side working pressure of 430 psig (29.6 bar) and a waterside working pressure of 150 psig (10.5 bar). Evaporator is tested at 1.1 times maximum allowable refrigerant side working pressure and 1.5 times maximum allowable water side working pressure. It has one water pass. Immersion heaters protect the evaporator to an ambient of -20°F (-29°C).

The evaporator is covered with factory-installed 0.75 inch (19.05 mm) Armaflex II or equal (k=0.28) insulation. Foam insulation is used on the suction line. Water pipe extensions with insulation go from the evaporator to the edge of the unit.

Condenser:

Air-cooled microchannel (MCHE) condenser coils use all aluminum brazed fin construction. Each slab is split horizontally into separate condensing and subcooling coils that are connected by either a copper tube or receiver tank. The maximum allowable working pressure of the condenser is 650 psig (44.8 bar). (MCHE) Condensers are factory proof tested to 650 psig (44.8 bar) and leak tested at 585 psig (40.3 bar). Coils can be cleaned with high pressure water.

Optional round tube and plate fin (RTPF) air-cooled condenser coils have aluminum fins mechanically bonded to internally-finned copper tubing. The condenser coil has an integral subcooling circuit. The maximum allowable working pressure of the condenser is 650 psig (44.8 bar). Condensers are factory proof tested at 650 psig (44.8 bar) and leak tested at 585 psig (40.3 bar).

Direct-drive vertical discharge condenser fans are balanced. Three-phase condenser fan motors with permanently lubricated ball bearings and external thermal overload protection are provided.

Units start and operate from 0°F to 125°F (-18°C to 52°C) for wide ambient. Wide ambient allows operation down to 0°F which is accomplished by a variable speed fan on each circuit that modulates to maintain system differential pressure.

Refrigerant Circuit and Capacity Modulation:

The 20-35 ton units have single refrigerant circuits. The 40-130 ton units have dual refrigerant circuits. Each refrigerant circuit has Trane scroll compressors piped in parallel with a passive oil management system. A passive oil management system maintains proper oil levels within compressors and has no moving parts. Each refrigerant circuit includes filter drier, electronic expansion valve, and liquid line and discharge service valves.

Capacity modulation is achieved by turning compressors on and off. The 20-35 ton units have two capacity stages. The 40-120 ton units have four capacity stages. The 130 ton unit has six capacity stages.

Unit Controls (Trane CH530):

The microprocessor-based control panel is factory-installed and factory-tested. The control system is powered by a pre-wired control power transformer, and will turn on and off compressors to meet the load. Microprocessor-based chilled water reset based on return water is standard.

The Trane CH530 microprocessor automatically acts to prevent unit shutdown due to abnormal operating conditions associated with low evaporator refrigerant temperature and high condensing temperature. If an abnormal operating condition continues and the protective limit is reached, the machine will shut down.

The panel includes machine protection for the following conditions:

• Low evaporator refrigerant temperature and pressure

• High condenser refrigerant pressure

• Critical sensor or detection circuit faults

• High compressor discharge temperature (with low temp evaporator)

• Lost communication between modules

• Electrical distribution faults: phase loss, phase reversal or over temperature protection

• External and local emergency stop

• Loss of evaporator water flow

When a fault is detected, the control system conducts more than 100 diagnostic checks and displays results. The display will identify the fault, indicate date, time, and operating mode at time of occurrence, and provide type of reset required and a help message.

Clear Language Display Panel:

Factory-mounted to the control panel door, the operator interface has an LCD touch-screen display for operator input and information output. This interface provides access to the following information: evaporator report, condenser report, compressor report, ASHRAE Guideline 3 report, operator settings, service settings, service tests, and diagnostics. All diagnostics and messages are displayed in “clear language.”

Data contained in available reports includes:

• Water and air temperatures

• Refrigerant pressures and temperatures

• Flow switch status

• EXV position

• Compressor starts and run-time

All necessary settings and setpoints are programmed into the microprocessor-based controller via the operator interface. The controller is capable of receiving signals simultaneously from a variety of control sources, in any combination, and priority order of control sources can be programmed. The control source with priority determines active setpoints via the signal it sends to the control panel. Control sources may be:

• Local operator interface (standard)

• Hard-wired 4-20 mA or 2-10 Vdc signal from an external source (interface optional; control source not supplied)

• Time of day scheduling (optional capability available from local operator interface)

• LonTalk® LCI-C (interface optional; control source not supplied)

• BACNet® (interface optional; control source not supplied)

• Trane Tracer® Summit system (interface optional; control source not supplied)

Quality Assurance:

The quality management system applied by Trane has been subject to independent third-party assessment and approval to ISO 9001-2008. The products described in this catalog are designed, manufactured and tested in accordance with the approved system requirements described in the Trane Quality Manual.

Options:

Application Options:

Electrical Options:

Circuit Breaker:

A molded case standard interrupting capacity circuit breaker, factory pre-wired with terminal block power connections and equipped with a lockable external operator handle, is available to disconnect the chiller from main power.

Powered Convenience Outlet:

Include powered convenience outlet with unit – powered via integral unit-mounted transformer. Outlet to power maintenance tools, and / or heat trace as required.

Control Options:

BACNet Interface:

Allows user to easily interface with BACNet® via a single twisted-pair wiring to a factory-installed and tested communication board.

Time of Day Scheduling:

Time of day scheduling capabilities are available for scheduling single chiller applications through Trane CH530 panel (without the need for building automation system - BAS). This feature allows the user to set up to ten events in a seven day time period.

External Chilled Water and Demand Limit Setpoint:

Controls, sensors, and safeties allow reset of chilled water temperature, based on temperature signal, during periods of low outdoor air temperature (chilled water reset based on return chilled water temperature is standard). The demand limit setpoint is communicated to a factory-installed and tested communication board through a 2-10 Vdc or 4-20 mA signal.

Percent Capacity:

Output the number of compressors that are operating as an analog 2-10 Vdc or 4-20 mA signal.

Programmable Relays:

Predefined, factory-installed, programmable relays allow the operation to select four relay outputs. Available outputs are: Alarm-Latching, Alarm-Auto Reset, General Alarm, Warning, Chiller Limit Mode, Compressor Running, and Tracer Control.

Other Options:

Architectural Louvered Panels

Louvered panels cover the complete condensing coil and service area beneath the condenser.

Comprehensive Acoustic Package:

This option includes acoustical treatment for compressor.

Condenser Coil – CompleteCoat:

Condenser coils are made of aluminum fins (plate fins) mechanically bonded to internally finned

copper tubes. The condenser box is then submerged in an epoxy polymer bath where an

electrostatic charge is used to uniformly deposit the epoxy onto the coil. This option resists bimetallic corrosion and allows for operation in coastal environments.

Isolators:

Molded elastomeric isolators sized to reduce vibration transmission to the supporting structure

when the unit is installed. Isolators ship with the chiller.

Isolators - Seismically Rated:

Spring isolators are designed and tested to control the motion of the chiller during a seismic event.

Performance Test:

Performance tests are available to certify chiller performance before shipment.

END OF SECTION 236423

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

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

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

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

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, 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.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway Power-limited cable, concealed in building finishes, or Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. 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.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
      a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
      b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. 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.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

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

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

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

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

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

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: [**Copper-clad**] steel; [**3/4 inch by10 feet**] in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

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

B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.
   8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
   9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
   10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
   1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Installbonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: [**10**] ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: [**5**] ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: [**3**] ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: [**3**] ohm(s).

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Designer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Equipment supports.

C. Welding certificates.

1.4 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors

or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with [**two-bolt conduit clamps**].

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: [**Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69**].
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

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

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

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

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. The work under this section includes conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes.

1.2 SUBMITTALS

A. Surface Raceway System - submit product data and catalog sheets for all components.

B. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.

B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 PVC COATED RIGID METAL CONDUIT

A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.

B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Conduit: Galvanized steel, threaded.

B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Conduit: Steel, galvanized tubing.

B. Fittings: All steel, set screw, water tight, concrete tight. No push-on or indenter types permitted.

C. Conduit Bodies: All steel threaded conduit bodies.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: steel, galvanized, spiral strip.

B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

2.7 RIGID NONMETALLIC CONDUIT AND FITTINGS

A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90^0 C conductors.

B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.8 SURFACE METAL RACEWAY

A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.

B. Size: As shown on Drawings.

C. Finish: Color selection by Architect.

D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.

E. Boxes and Extension Rings: Designed for use with raceway systems.

2.9 SURFACE NONMETAL RACEWAY

A. Description: Nonmetallic channel with fitted cover, suitable for use as surface raceway.
B. Size: As shown on Drawings.
C. Finish: Color selection by Architect.
D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
E. Boxes and Extension Rings: Designed for use with raceway systems.

2.10 AUXILIARY GUTTERS (Wireways)

A. Description: General purpose, Oil-tight and dust- tight, or Rain-tight type wireway without knockouts.
B. Size: Cross-section and length as indicated on drawings.
C. Cover: Hinged cover with full gasketing, where required by application.
D. Connector: [hinged cover.]
E. Fittings: Lay-in type with [removable top, bottom, and side; captive screws.]
F. Finish: Rust inhibiting primer coat with gray enamel finish.

2.11 OUTLET BOXES

A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
C. Concrete Ceiling Boxes: Concrete type.
D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

2.12 FLOOR BOXES

A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: As shown and detailed on Drawings.

2.13 PULL AND JUNCTION BOXES

A. Pull boxes and junction boxes shall be minimum 4 inch square (100 mm) by 2 1/8th inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square (117 mm).
B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4” and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.
C. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
D. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
F. Fiberglass or Concrete Handholes with weatherproof cover of non-skid finish shall be used for underground installations.
G. Box extensions and adjacent boxes within 48” of each other are not allowed for the purpose of creating more wire capacity.
H. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
I. Wireways shall not be used in lieu of junction boxes.

2.14 GENERAL

A. All steel fittings and conduit bodies shall be galvanized.

B. No cast metal, split or gland type fittings permitted.
C. Condulets larger than 2 inch are (50 mm) not permitted except as approved or detailed.
D. All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.
E. Wireways and gutters shall not be used in lieu of pull boxes and condulets.
F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

A. EMT is permitted to be used in sizes 4" and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch minimum except as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**
C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
D. Arrange conduit to maintain headroom and present a neat appearance.
E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
G. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
H. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
I. Support and fasten metal conduit at a maximum of 8 feet on center, and as required by NEC.
J. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, etc., unless so approved or detailed.
K. In general, all conduits shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
L. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
M. No continuous conduit run shall exceed 100 feet without a junction box.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipecutter; de-burr cut ends.
B. Conduit shall not be fastened to the corrugated metal roof deck.
C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations (sheet metal boxes 4 & 11/16th” square and larger, shall contain NO pre-punched or concentric knockouts).

E. All conduit terminations (except for terminations into conduit bodies) shall use connectors or conduit hubs with one locknut or shall use double locknuts (one each side of box wall) and insulating bushing. Provide bushings for the ends of all conduits not terminated in box walls. Refer to Division 26 Sections for grounding bushing requirements.
F. Install no more than the equivalent of three 90 degree bends between boxes.
G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size unless sweep elbows are required.
H. Conduit shall be bent according to manufacturers' recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.
I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
J. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
M. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
N. Route conduit through roof openings for piping and ductwork where possible.
O. Ground and bond conduit per other Division 26 Sections.
P. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor. Transition shall be under the slab or under grade, with a rigid 90-degree bend or elbow.
Q. Use PVC-coated rigid steel factory elbows for bends in plastic conduit larger than 2". PVC elbows are allowed in PVC conduit runs 2" and smaller.
R. All conduit installed underground (exterior to building) shall be buried a minimum of 24" below finished grade, whether or not the conduit is concrete encased.
S. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturers' recommendations.
T. Medium voltage conduit may be installed in interior locations other than electrical vaults only with special permission from Architect/Engineer.

3.3 CONDUIT INSTALLATION SCHEDULE

A. Conduit other than that specified below for specific applications shall not be used.
B. Underground Installations within five feet of foundation fall: Rigid steel conduit.
C. Underground Installations more than five feet from foundation fall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit. Install in concrete duct bank as detailed on Drawings.
D. Under Slab on Grade Installations: Schedule 40 PVC conduit. Where conduit turns up through slab and is exposed, elbow shall be rigid steel conduit.
E. Exposed Outdoor Locations: Rigid steel conduit.
F. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Metallic Tubing (EMT).
G. Wet Interior Locations: Rigid steel conduit.

H. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
I. Exposed Dry Interior Locations: Rigid steel conduit.
J. Motor and equipment connections: Flexible PVC coated metal conduit (wet, damp, or dry locations). Flexible metal conduit (dry locations only). Minimum length shall be one foot; maximum length shall be three feet. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
K. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit (fixture whip) from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six foot maximum length. Conduit length shall allow movement of fixture for maintenance purposes. Contractor may use Type MC metal-clad cable in lieu of conduit/wire for fixture whips, size and wire size as specified above.
L. Medium Voltage Applications (Interior Locations): Rigid steel conduit.

3.4 SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION

A. Use flat-head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.
B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
C. Maintain grounding continuity between raceway components to provide a continuous grounding path per Division 26 Sections.
D. Fastener Option: Use clips and straps suitable for the purpose.

3.5 NONMETALLIC SURFACE RACEWAY INSTALLATION

A. Use flat headed screws with appropriate anchors to fasten channel to surfaces secured every twenty-four (24) inches. Mount plumb and level. All surface mounted devices shall be fastened to the wall utilizing flat head screws along with appropriate anchors. No device shall be adhered to the wall surface using two-faced tape or any means other than as described above.
B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
C. In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.
D. The non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.
E. The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.
F. All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.
G. The raceway and all systems devices shall be UL listed and exhibit nonflammable self extinguishing characteristics, tested to specifications of UL94V-0.
H. The raceway and all systems devices shall adhere to the EIA/TIA Category 5e bend radius standard.

3.6 AUXILIARY GUTTERS (Wireways) INSTALLATION

A. Bolt auxiliary gutter to wall using two-piece hangers or steel channels fastened to the wall or in self-supporting structure.
B. Gasket each joint in oil-tight gutter.
C. Mount rain-tight gutter in horizontal position only.
D. Maintain grounding continuity between raceway components to provide a continuous grounding path under Division 26 Sections.

E. Provide terminal blocks for wiring terminations in auxiliary gutters and wireways.

3.7 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. No outlet shall be located where it will be obstructed by other equipment, piping, lockers, benches, casework, etc.

D. Boxes shall not be fastened to the metal roof deck.

E. Contractor shall study drawings pertaining to other trades, discuss location of outlets with workmen installing other piping, equipment, casework, furnishing, etc., and fit all electrical outlets to job conditions. In case of conflicts, notify Designer prior to installation.

F. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

G. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch by 24 inch access doors.

H. Locate and install to maintain headroom and to present a neat appearance.

I. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.8 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

B. Power: Recessed (1/4” maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

C. Low Voltage: Recessed (1/4” maximum) outlet boxes in masonry, concrete or tile construction shall be masonry type, minimum 4 11/16 inch square. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.

D. Provide knockout closures for unused openings.

E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.

F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

G. Install boxes in walls without damaging wall insulation.

H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

I. Ceiling outlets shall be 4 inch octagon or 4 inch square, minimum 2-1/8 inch deep except that concrete boxes and plates will be approved where applicable. Position outlet boxes to locate luminaires as shown on reflected ceiling plans. All ceiling outlets shall be equipped with 3/8 inch fixture studs.

J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use

stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

N. Surface wall outlets shall be 4 inch square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

3.9 FLOOR BOX INSTALLATION

A. Set boxes level and flush with finish flooring material.

3.10 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed.

B. Support pull and junction boxes independent of conduit.

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes performance requirements for delegated design of vibration and seismic controls.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural Drawings for Seismic Design Category, Building Use Group, and Seismic design parameters.

1.3 SUBMITTALS

A. Product Data: For all products provided.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint calculations and details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

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

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

A. Products shall be selected by engineer providing delegated design services.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Delegated Design Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
F. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
G. Drilled-in Anchors:
    1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
    2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
    3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
    4. Set anchors to manufacturer's recommended torque, using a torque wrench.
    5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.3 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:
    1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
    2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
    3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
    4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
    5. Test to 90 percent of rated proof load of device.
    6. Measure isolator restraint clearance.
    7. Measure isolator deflection.
    8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
C. Remove and replace malfunctioning units and retest as specified above.
D. Prepare test and inspection reports, certified by Professional Engineer who provided Delegated Design.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Equipment identification labels.
   4. Ceiling identification labels.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

F. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with color code as described below. Minimum letter height shall be 3/8 inch.

2.4 CEILING IDENTIFICATION LABELS

A. Permanent, self-adhesive ¾” diameter colored labels

PART 3 - EXECUTION

3.1 APPLICATION

A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage using color code as described below. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
a. Power transfer switches.
b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
a. Indoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
2. Equipment to Be Labeled:
a. Panelboards, electrical cabinets, and enclosures.
b. Electrical switchgear and switchboards.
c. Transformers.
d. Motor-control centers.
e. Disconnect switches.
f. Enclosed circuit breakers.
g. Motor starters.
h. Push-button stations.
i. Power transfer equipment.
j. Contactors.

D. Ceiling identification labels
1. Install ceiling identification labels on ceiling grid below junction boxes, switches, and other items that require adjustment.
2. Install prior to installation of ceiling tile.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied.
   2. Colors for 208/120-V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White
   3. Colors for 480/277-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray
   4. Isolated Circuits:
      a. Hot: Orange
      b. Neutra: Brown

F. Color-Coding for Equipment Identification: Use the colors listed below for equipment.
   1. Blue surface with white core for 120/208 volt equipment.
   2. Black surface with white core for 277/480 volt equipment.
   3. Bright red surface with white core for all equipment related to fire alarm system.
   4. Dark red (burgundy) surface with white core for all equipment related to security.
   5. Green surface with white core for all equipment related to "emergency" systems.
   6. Orange surface with white core for all equipment related to telephone systems.
   7. Brown surface with white core for all equipment related to data systems.
   8. White surface with black core for all equipment related to paging systems.
   9. Purple surface with white core for all equipment related to TV systems.

G. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers above lift-out and other type accessible ceilings.

H. All J-box covers to be identified with circuit number.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.3 SUBMITTALS

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

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

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

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen Areas: NEMA 250, Type 4X,.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom, as shown on Drawings.
D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: [**Hard-drawn copper, 98 percent conductivity**].
2. Main and Neutral Lugs: [**Mechanical**] type.
3. Ground Lugs and Bus Configured Terminators: [**Mechanical**] type.
4. Feed-Through Lugs: [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
F. Service Equipment Label: NRTL labeled for use as service equipment for all panelboards.
G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
J. Provide surge protection devices on all emergency panelboards per NEC 700.8. Refer to electrical specification section: 264313 Transient-Voltage Surge Suppression for details.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
B. Panelboards: NEMA PB 1, power and feeder distribution type.
C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
D. Mains: Circuit breaker, Fused switch, or Lugs only, as indicated on drawings.
E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: [**Bolt-on**] circuit breakers.
F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
G. Branch Overcurrent Protective Devices: Fused switches.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.
B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
C. Mains: Circuit breaker or lugs only.
D. Branch Overcurrent Protective Devices: [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.
E. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: [**120-V branch circuit**].

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.1 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES. (SERVICE ENTRANCE MAIN BREAKER TO BE GFI PROTECTED PER NEC 230.95)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**interrupting capacity**] to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: [**Mechanical**] style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: [**Integrally mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Communication Capability: [**Circuit-breaker-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
f. Shunt Trip: [**120**] -V trip coil energized from separate circuit, set to trip at [**55**] percent of rated voltage.
g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on or off**] position.
h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
   1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.2 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to [**NECA 407**] [**NEMA PB 1.1**].

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

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

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 STUDIES

A. Electrical Contractor to provide a complete short circuit and selective coordination study from the service entrance to all end devices. The study shall be provided by the switchgear manufacturer and utilize time current curves provided by manufacturer for the specific project. The study shall be made available for engineer's review and included with shop drawings.

B. The selective coordination study shall meet the requirements described by NEC Articles 700.32, 701.27, 708.54, and 620.62.

C. The minimum NEC requirement for the selective coordination study is applicable to the systems described in NEC Articles 700.32, 701.27, 708.54, and 620.62, and as indirectly referenced for essential electrical systems in Article 517.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Wall-box motion sensors.
   3. Snap switches and wall-box dimmers.
   4. Solid-state fan speed controls.
   5. Wall-switch and exterior occupancy sensors.
   6. Communications outlets.

B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

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

1.3 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product: As shown on Drawings.

B. Comparable Products by Cooper, Hubbell, Leviton, Pass & Seymour.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed or non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A.

C. Pilot Light Switches, 20 A.
   1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A.
   1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors and where otherwise indicated.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors and where otherwise indicated, with factory-supplied key in lieu of switch handle.

2.5 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider, toggle switch, or rotary knob; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. Wattage as shown on Drawings; dimmers shall require no derating when ganged with other devices.
D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
   1. Continuously adjustable slider, toggle switch, or rotary knob, 5 A.
   2. Three-speed adjustable slider or rotary knob, 1.5 A.

2.7 OCCUPANCY SENSORS

A. Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
B. Wall-Switch Sensors:
   1. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..
C. Long-Range Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..
D. Long-Range Wall-Switch Sensors:
   1. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft..
E. Wide-Range Wall-Switch Sensors:
   1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft..
F. Exterior Occupancy Sensors:
   1. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.8 COMMUNICATIONS OUTLETS

A. Telephone Outlet:
   1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.
B. Combination TV and Telephone Outlet:
   1. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.9 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: 0.035-inch- thick, satin-finished stainless steel.
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, [**flush-type**], dual-service units suitable for wiring method used.
B. Compartments: Barrier separates power from voice and data communication cabling.
C. Service Plate: [**Round**], [**die-cast aluminum**] with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
E. Voice and Data Communication Outlet: [**Blank cover with bushed cable opening**].

2.11 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.
C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles [**down**], and on horizontally mounted receptacles to the [**right**].

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 262726

F O R M OF P R O P O S A L

Historic Courthouse Chiller Replacements Contract: Mechanical

Henderson County, NC Bidder: _____

Date: _____

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto, and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed.

The Bidder proposes and agrees if this proposal is accepted to contract with the Henderson County Government, Hendersonville, NC, in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of Henderson County Historic Courthouse Chiller Replacements in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the Henderson County Government with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

SINGLE PRIME CONTRACT: _____

Base Bid: _____ Dollars($) _____

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereto within the time specified in the Supplementary General Conditions.

Proposal Signature Page

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of _____

_____
(Name of firm or corporation making bid)

WITNESS:

_____
(Proprietorship or Partnership)

By:_____
Signature

Name: _____
Print or type

Title_____
(Owner/Partner/Pres./V.Pres)

Address_____

_____

ATTEST:

By:_____

Title:_____
(Corp. Sec. or Asst. Sec. only)

License No._____

Federal I.D. No. _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 ___ Addendum No. 2 ___ Addendum No. 3 ____ Addendum No. 4 ___

FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT

_____ as

principal, and _____, as surety, who is duly licensed to act as surety in North Carolina, are held and firmly bound unto the State of North Carolina***** through

_____ as obligee, in the penal sum of

_____ DOLLARS, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this ____ day of _____ 20__

WHEREAS, the said principal is herewith submitting proposal for **Henderson County Historic Courthouse Chiller Replacements** and the principal desires to file this bid bond in lieu of making the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if the principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bond for the faithful performance thereof within ten days after the award of same to the principal, then this obligation shall be null and void; but if the principal fails to so execute such contract and give performance bond as required by G.S. 143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

THIS AGREEMENT, made the _____ day of _____ in the year of 2021 by and between _____. hereinafter called the Party of the First Part and Henderson County Government, hereinafter called the Party of the Second Part.

WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein named agree as follows:

1. Scope of Work: The Party of the First Part shall furnish and deliver all of the materials, and perform and documents, which are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage and builder's risk insurance certificates; and drawings, titled: **Henderson County Historic Courthouse Chiller Replacements.**

Consisting of the following sheets: M0.1, M0.2, M1.0, M2.0

Consisting of the following specifications: Mechanical, Electrical

Dated: November 29, 2021 and the following addenda:

Addendum No	_____	Dated:	_____	Addendum No.	_____	Dated:	_____
Addendum No	_____	Dated:	_____	Addendum No.	_____	Dated:	_____
Addendum No	_____	Dated:	_____	Addendum No.	_____	Dated:	_____
Addendum No	_____	Dated:	_____	Addendum No.	_____	Dated:	_____

2. That the Party of the First Part shall commence work to be performed under this agreement on a date to be specified in a written order of the Party of the Second Part and shall fully complete all work hereunder within 120 consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by the various divisions or part of the work and by calendar days. If the Party of the First Part fails to begin the work under the contract within the time specified, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the Party of the First Part shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the Party of the Second Part may give notice in writing, sent by certified mail, return receipt requested, to the Party of the First Part and his surety of such delay, neglect or default, specifying the same, and if the Party of the First Part within a period of fifteen (15) days after such notice shall not proceed in accordance therewith, then the Party of the Second

Part shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within fifteen (15) days after being so notified and notify the Party of the Second Part in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the Party of the Second Part shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said Party of the First Part, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the Party of the Second Part, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said Party of the First Part and surety. In case the expense so incurred by the Party of the Second Part shall be less than the sum which would have been payable under the contract, if it had been completed by said Party of the First Part, then the said Party of the First Part and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the Party of the First Part and the surety shall be liable and shall pay to the Party of the Second Part the amount of said excess.

3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows:

_____ ($_____).

Summary of Contract Award: **Plumbing as described in Contract Documents.**
Project / Total Above to include Base Bid work as shown on Contract.

4. On or before the 20th day of each calendar month, the Party of the Second Part shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in 3 (three) counterparts, each of which shall without proof or accounting for other counterparts, be

deemed an original contract.

Witness:

_____ Contractor: (Trade or Corporate Name)

_____ By: _____

(Proprietorship or Partnership)

Title: _____

(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____

(Corp. Sec. or Asst. Sec. only) (CORPORATE SEAL)

Henderson County Government:

By: _____

Title: _____

Date: _____

Witness:

By: _____

Title: _____

Date: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal (Contractor) _____

Name of Surety: _____

Name of Contracting Body: Henderson County Government

Amount of Bond: _____

Project **Henderson County Historic Courthouse Chiller Replacements**

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

_____
(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

_____
Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

_____
(Surety Company)

Witness:

_____

By: _____

Title: _____
(Attorney in Fact)

Countersigned:

_____

(Surety Corporate Seal)

_____
(N.C. Licensed Resident Agent)

_____

_____
Name and Address-Surety Agency

_____

_____
Surety Company Name and N.C. Regional or Branch Office Address

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal (Contractor) _____

Name of Surety: _____

Name of Contracting Body: Henderson County Government

Amount of Bond: _____

Project **Henderson County Historic Courthouse Chiller Replacements**

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in _____ counterparts.

Witness:

Contractor: (Trade or Corporate Name)

By:

(Proprietorship or Partnership)

Attest: (Corporation)

Title:
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By:

Title:
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

(Surety Company)

Witness:

By:

Title:
(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C. Regional or Branch Office Address

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

OUTREACH PLAN AND GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN HENDERSON COUNTY BUILDING CONSTRUCTION CONTRACTS

In accordance with G.S. 143-128.2, these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, Construction Manager-at-Risk, and alternative contracting methods on Henderson County building construction projects in the amount of $300,000 or more. The Outreach Plan shall also be applicable to the selection process of architectural, engineering and Construction Manager-at-Risk services.

Henderson County's current goal for minority participation for public building construction is five percent (5%) (established by action of the Board of Commissioners on November 20, 1996). The overall goal will be reviewed annually or as soon as relevant data is available.

SECTION I: INTENT

The intent of these guidelines is that Henderson County, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded, shall cooperate and in good faith do all things, legal, proper and reasonable to achieve the statutory goal of five percent (5%) for participation by minority businesses in each construction project as mandated by G.S. 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to, or to make purchases of materials or equipment from, minority-business contractors or minority-business subcontractors who do not submit the lowest responsible responsive bid or bids.

SECTION II: DEFINITIONS

1. Minority — a person who is a citizen or lawful permanent resident of the United States and who is:

    a. Black, that is, a person having origins in any of the black racial groups in Africa;
    b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
    c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, or the Pacific Islands;
    d. American Indian, that is, a person having origins in any of the original peoples of North America; or
    e. Female

2. Minority Business — means a business

    a. In which at least fifty-one percent (51 %) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty- one percent (51 %)

of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and

b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.

3. Socially and economically disadvantaged individual — means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".

4. Public Entity — Means State and all public subdivisions and local government units.

5. Owner — Henderson County.

6. Designer — Any person, firm, partnership, or corporation, which has contracted with Henderson County to perform architectural or engineering work.

7. Bidder — Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

8. Contract - A mutually binding legal relationship, or any modification thereof, obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.

9. Contractor — Any person, firm, partnership, corporation, association, or joint venture which has contracted with Henderson County to perform construction work or repair.

10. Subcontractor — A firm under contract with the prime contractor or Construction Manager-at-Risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in the contract.

SECTION III: RESPONSIBILITIES OF PARTIES

A. OWNER RESPONSIBILITIES: MINORITY AND SMALL BUSINESS PARTICIPATION OUTREACH PLAN

1. Work with minority-focused and small business groups that support MBE and small business inclusion in the solicitation of bids. These groups include the CVCC Small Business Development Center and the Small Business Technology Center.

2. Place more emphasis on the importance of soliciting certified MBE firms and small businesses for subcontracting opportunities at pre-bid conferences and in the bid documents. Examine specifications to identify special subcontracting opportunities and strongly encourage prime contractors to solicit bids for subcontracts from MBE firms.

3. Provide detailed information to majority contractors concerning the Guidelines for Recruitment and Selection of Minority Business and Outreach Plan and provide information on G.S. 143-129 by holding meetings with the contractors.

4. Assess the effectiveness of the MBE Program, and identify opportunities to enhance it, by evaluating MBE participation and compliance and reviewing the "good faith efforts" provided in bid packages.

5. Identify subcontracting opportunities unique to each construction contract and project and concentrate heavily on targeting certified MBE firms and small businesses that have expressed an interest in Henderson County projects. Identify these opportunities and contact interested businesses no later than 10 days prior to the bid opening and provide a list of prime contractors planning to participate in the project.

6. Build new business relationships through networking and continue networking with other North Carolina cities and counties to find out how their Outreach Program and MBE program is working and sharing "best practices" and ideas to improve the program.

7. Participate in education opportunities throughout the community as they become available and offer training sessions to share the County's Outreach Plan with interested businesses and organizations.

8. Be visible through participation in trade shows and business organizations of interest to MBE firms, majority contractors and small businesses, and provide information to the general public about the MBE Program, and continue outreach efforts to the business community.

9. Enhance the County's web page by including the Outreach Plan and Guidelines, listing good faith efforts, and creating links to MBE resources, and creating awareness of specific subcontracting opportunities.

10. Make available to minority-focused agencies, a list of subcontracting opportunities when they are identified, no later than 10 days prior to the bid opening, and a list of prime bidders that subcontractors may wish to contact for subcontracting consideration.

11. Continue to maintain a database specifically for MBE firms and majority contractors to ensure those firms wishing to do business with Henderson County have access to up to date information.

12. Advertise upcoming bid opportunities in minority-focused media.

13. Work with architects and engineers to make subcontracting opportunities more noticeable and more easily understood by potential contractors and subcontractors.

B. DESIGNER RESPONSIBILITIES

Under the single-prime bidding, separate prime bidding, dual bidding, Construction Manager-at-Risk, or alternative contracting method, the designer must do all of the following:

1. Attend the scheduled pre-bid conference to explain minority business requirements to the prospective bidders.

2. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential and contracting opportunities.

3. Maintain documentation of any contacts, correspondence, or conversations with minority business firms made in an attempt to meet the goals.

4. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) — (i.e. bidders' proposal for identification of the minority businesses that will be utilized with corresponding dollar value of the bid and affidavit listing Good Faith Efforts or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) — prior to recommendation of an award.

5. During the construction phase of the project, review "MBE Documentation for Contract Payment" form with monthly pay applications to the owner and forward copies to Henderson County.

C. PRIME CONTRACTOR(S). CONSTRUCTION MANGER AT RISK. AND FIRST TIER SUBCONTRACTOR

Under the single prime bidding, the separate-prime bidding dual bidding, Construction Manager-at-Risk and alternative contracting methods, contractor(s) must do all of the following:

1. Attend the scheduled pre-bid conference.

2. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.

3. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification must include all of the following:

   a. A description of the work for which the sub-bid is being solicited.
   b. The date, time and location where sub-bids are to be submitted.
   c. The name of the individual within the company who will be available to answer questions about the project.
   d. Where bid documents may be reviewed.
   e. Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

4. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.

5. Identify on the bid the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f) or intent to Perform Contract With Own Workforce affidavit.

6. Make documentation showing evidence of implementation of Prime Contractor, Construction Manager-at-Risk and First Tier Subcontractor responsibilities available for review by Henderson County upon request.

7. Provide one of the following upon being named the apparent low bidder.

   a. an affidavit that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal. This affidavit shall give rise to a presumption that the bidder has made required good faith effort; or

   b. if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. The documentation must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations, and evidence of other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.

8. Identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values.

9. Submit with each monthly pay request(s) and final payment(s), "MBE Documentation for Contract Payment" for designer's review.

10. If at any time during the construction of a project, it becomes necessary to replace a minority business subcontractor; immediately advise the owner in writing of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.

11. Make a good faith effort to solicit sub-bids from minority businesses during the construction of a project if addition subcontracting opportunities become available.

D. MINORITY BUSINESS RESPONSIBILITES

Henderson County does not certify minority, disadvantaged or woman-owned businesses. Any business which desires to participate as an MBE will be required to complete and submit for certification, documents required by the agencies listed below. Only those firms holding current certification through at least one of the following agencies will be considered eligible for inclusion in meeting the MBE participation percentage goals:

1. North Carolina Administration Department Historically Underutilized Business (HUB) certification.

2. North Carolina Department of Transportation Minority/Disadvantage/Woman owned Business certification.

3. Small Business Administration 8(a) certification.

4. Other governmental agencies on a case-by-case basis.

A copy of these guidelines will be issued with each bid package for Henderson County building construction projects. These guidelines shall apply to all contractors regardless of ownership.

SECTION IV: MINIMUM COMPLIANCE REQUIREMENTS

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and Henderson County for the performance of the contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business guidelines shall constitute a breach of contract. A finding by the County that any information, submitted either prior to award of the contract or during the performance of the contract, is inaccurate, false, or incomplete, shall constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of Henderson County whether to terminate the contract for breach.

In determining whether a contractor has made a Good Faith Efforts, Henderson County will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Contractors are required to earn at least 50 points. Failure to file a required affidavit or documentation that demonstrates that the contractor made the required good faith effort is grounds for rejection of the bid.

1. Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed. *Value = 10 Points*

2. Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due. *Value = 10 Points*

3. Breaking down or combining elements of work in economically feasible units to facilitate minority participation. *Value = 15 Points*

4. Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and those included in the bid documents to provide assistance in recruitment of minority businesses. *Value = 10 Points*

5. Attending any pre-bid meetings scheduled by the public owner. *Value = 10 Points*

6. Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors. *Value — 20 Points*

7. Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing. *Value = 15 Points*

8. Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit. *Value = 25 Points*

9. Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public building construction or repair project when possible. *Value = 20 Points*

10. Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands. *Value = 20 Points*

Approved this the 16 day of October, 2002
HENDERSON COUNTY BOARD OF COMMISSIONERS