



North Carolina School of Science and Mathematics

Specifications Construction Documents

NC School of Science and Mathematics
Campus-Wide HVAC Renovations – Phase 1

September 5, 2025

SCO ID #: 24-28565-01A
Code: 42119 Item: 306



4300 Edwards Mill Road, Suite 200
Raleigh, NC 27612
License # F-1222

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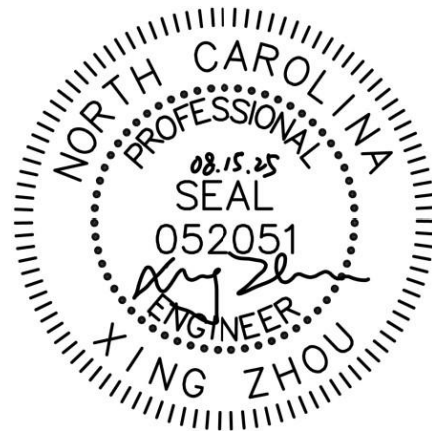
COUNTY SALES USE TAX FORM

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**Advertisement For Bids &
Notice of Public Meeting for Proposed Alternate Bids for Preferred Products**

Sealed proposals will be received until 3:00pm on October 2, 2025, at Bryan Center Conference Room 109, NC School of Science and Mathematics, 1219 Broad Street, Durham, NC and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment for the construction of:

**NC School of Science and Mathematics
Campus-Wide HVAC Renovations – Phase 1
Durham, NC
SCO ID No.: 24-28565-01A Code: 42119 Item: 306**

Bids will be received for single prime bid contracts. All Proposals will be lump sum.

Complete plans and specifications for this project are available digitally and can be obtained from McKim & Creed by emailing Allison Jurgens at ajurgens@mckimcreed.com beginning on September 8, 2025.

Bid documents will also be available for examination with Construct Connect (including iSqFt, CMD Group and Hispanic Contractors of Carolinas) and Dodge Construction.

The bidder must include completed minority business subcontractor documentation form(s) with their proposal or the bid may be considered non-responsive and invalid.

Pre-Bid Meeting and Notice of Public Meeting for Proposed Alternate Bids for Preferred Products

A public meeting will be held for all interested bidders at 3:30pm on September 11, 2025, at Bryan Center Conference Room 109, NC School of Science and Mathematics, 1219 Broad Street, Durham, NC. The meeting will address project specific questions and issues for preferred brand products.

In accordance with GS133-3, Section 64. (C) and State Construction Office procedures, the following preferred brand items are being considered as Alternates by the Owner for this project:

- BACnet based building automation system by Trane controls

The State reserves the unqualified right to reject any and all proposals.

NC School of Science and Mathematics
1219 Broad Street
Durham, NC 27705

NOTICE TO BIDDERS

Sealed proposals will be received until 3:00pm on October 2, 2025, at Bryan Center Conference Room 109, NC School of Science and Mathematics, 1219 Broad Street, Durham, NC and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment for the construction of:

**NC School of Science and Mathematics
Campus-Wide HVAC Renovations – Phase 1
Durham, NC
SCO ID No.: 24-28565-01A Code: 42119 Item: 306**

The Work consists of the following: NC School of Science and Mathematics (NCSSM) is an existing public high school located in Durham, NC. Primary scope of this project is replacing central air handling units for Hunt Residence Hall (additional HVAC scope and ancillary items are fully defined on the mechanical drawings and specifications). Electrical scope will include power system modifications to service to new mechanical equipment as shown on electrical drawings and specifications.

Bids will be received for single prime contract. All proposals shall be lump sum.

Pre-Bid Meeting and Notice of Public Meeting for Proposed Alternate Bids for Preferred Products

A public meeting will be held for all interested bidders at 3:30pm on September 11, 2025, at Bryan Center Conference Room 109, NC School of Science and Mathematics, 1219 Broad Street, Durham, NC. The meeting will address project specific questions and issues for preferred brand products.

In accordance with General Statute GS 133-3, Specifications may list one or more preferred brands as an alternate to the base bid in limited circumstances. Specifications containing a preferred brand alternate under this section must identify the performance standards that support the preference. Performance standards for the preference must be approved in advance by the owner in an open meeting. Any alternate approved by the owner shall be approved only where (i) the preferred alternate will provide cost savings, maintain or improve the functioning of any process or system affected by the preferred item or items, or both, and (ii) a justification identifying these criteria is made available in writing to the public.

Complete plans, specifications and contract documents will be available for inspection in the plan rooms of Construct Connect (including iSqFt, CMD Group and Hispanic Contractors of Carolinas) and Dodge Construction or may be obtained from McKim & Creed by emailing Allison Jurgens at ajurgens@mckimcreed.com beginning on September 8, 2025.

The bidder shall include with the bid proposal the form *Identification of Minority Business Participation* identifying the minority business participation it will use on the project and shall include either *Affidavit A* or *Affidavit B* as applicable. Forms and instructions are included within the Proposal Form in the bid documents. Failure to complete these forms is grounds for rejection of the bid. (GS143-128.2c Effective 1/1/2002)

All contractors are hereby notified that they must have proper license as required under the state laws governing their respective trades.

General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for General Contractor (Unlimited) or Licensed Mechanical Contractor.

Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure or improvement shall be deemed a “general contractor” and shall be so licensed. Therefore a single prime project that involves other trades will require the single prime contractor to hold

a proper General Contractors license. On public buildings being bid single prime, where the total value of the general construction does not exceed 25% of the total construction value, contractors under GS87-Arts 2 and 4 (Mechanical) may bid and contract directly with the Owner as the SINGLE PRIME CONTRACTOR and may subcontract to other properly licensed trades. [GS87-1.1- Rules .0210](#)

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, of an amount equal to not less than five percent (5%) of the proposal, or in lieu thereof a bidder may offer a bid bond of five percent (5%) of the bid executed by a surety company licensed under the laws of North Carolina to execute the contract in accordance with the bid bond. Said deposit shall be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten days after the award or to give satisfactory surety as required by law.

A performance bond and a payment bond will be required for one hundred percent (100%) of the contract price.

Payment will be made based on ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

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

The owner reserves the right to reject any or all bids and to waive informalities.

Designer:
McKim & Creed
4300 Edwards Mill Road, Suite 200
Raleigh, NC 27612
919-233-8091

Owner:
NC School of Science and Mathematics

**INSTRUCTIONS TO BIDDERS
AND
GENERAL CONDITIONS OF THE CONTRACT**

STANDARD FORM FOR CONSTRUCTION PROJECTS

**STATE CONSTRUCTION OFFICE
NORTH CAROLINA
DEPARTMENT OF ADMINISTRATION**

Form OC-15

This document is intended for use on State capital construction projects and shall not be used on any project that is not reviewed and approved by the State Construction Office. Extensive modification to the General Conditions by means of “Supplementary General Conditions” is strongly discouraged. State agencies and institutions may include special requirements in “Division 1 – General Requirements” of the specifications, where they do not conflict with the General Conditions.

Twenty Fourth Edition January 2013

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 therefor, and all blank spaces for bids, alternates, and unit prices applicable to bidder's work shall be properly filled in. When requested alternates are not bid, the proposer shall so indicate by the words "No Bid". Any blanks shall also be interpreted as "No Bid". 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. If figures and writing differ, the written number will supersede the figures.

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

Bidder shall 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 or an affidavit indicating work under contract will be self-performed, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f). Failure to comply with these requirements is grounds for rejection of the bid.

For projects bid in the single-prime alternative, the names and license numbers of major subcontractors shall be listed on the proposal form.

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

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.

2. EXAMINATION OF CONDITIONS

It is understood and mutually agreed that by submitting a bid the bidder 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 bidder 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 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 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 should be acknowledged by the bidder(s) on the Form of Proposal. However, even if not acknowledged, by submitting a bid, the bidder has certified that he has reviewed all issued addenda and has included all costs associated within his bid.

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 (G.S. 143-129).

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 than 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 and shall be used.

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 the closing of the bid, the bidder will be permitted to change or withdraw his bid. Guidelines for opening of public construction bids are available from the State Construction Office.

6. OPENING OF BIDS

Upon opening, all bids shall be read aloud. Once bidding is closed, 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 opening of bids, no bid may be withdrawn, except under the provisions of General Statute 143-129.1, 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 and the State Construction Office.
- 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.
- g. If prequalified, contractor info will be reviewed and evaluated comparatively to submitted prequalification package.

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, responsive bidder, the owner shall take into consideration the bidder's compliance with the requirements of G.S. 143-128.2(c), the past performance of the bidder on construction contracts for the State with particular concern given to completion times, quality of work, cooperation with other contractors, and cooperation with the designer and owner. Failure of the low bidder to furnish affidavit and/or documentation as required by G.S. 143-128.2(c) shall constitute a basis for disqualification of the bid.

Should the owner adjudge that the apparent low bidder is not the lowest responsible, responsive 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.

11. PRE-BID CONFERENCE

Prior to the date set for receiving bids, the Designer may arrange and conduct a Pre-Bid Conference for all prospective bidders. The purpose of this conference is to review project requirements and to respond to questions from prospective bidders and their subcontractors or material suppliers related to the intent of bid documents. Attendance by prospective bidders shall be as required by the "Notice to Bidders".

12. SUBSTITUTIONS

In accordance with the provisions of G.S. 133-3, material, product, or equipment substitutions proposed by the bidders to those specified herein can only be considered during the bidding phase until ten (10) days prior to the receipt of bids when submitted to the Designer with sufficient data to confirm material, product, or equipment equality. Proposed substitutions submitted after this time will be considered only as potential change order.

Submittals for proposed substitutions shall include the following information:

- a. Name, address, and telephone number of manufacturer and supplier as appropriate.
- b. Trade name, model or catalog designation.
- c. Product data including performance and test data, reference standards, and technical descriptions of material, product, or equipment. Include color samples and samples of available finishes as appropriate.
- d. Detailed comparison with specified products including performance capabilities, warranties, and test results.
- e. Other pertinent data including data requested by the Designer to confirm product equality.

If a proposed material, product, or equipment substitution is deemed equal by the Designer to those specified, all bidders of record will be notified by Addendum.

GENERAL CONDITIONS OF THE CONTRACT

The use or reproduction of this document or any part thereof is authorized for and limited to use on projects of the State of North Carolina, and is distributed by, through and at the discretion of the State Construction Office, Raleigh, North Carolina, for that distinct and sole purpose.

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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; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.
- b. The **owner** is the State of North Carolina through 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. For the purposes of a single prime contract, the term Contractor shall be deemed to be the single contracting entity identified as the "Party of the First Part" in the single Construction Contract. Any references or adjectives that name or infer multiple prime contractors shall be interpreted to mean the single prime Contractor.
- 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, is an entity stated in the contract documents, designated to effectively facilitate scheduling and coordination of work activities. See Article 14(f) for responsibilities of a Project Expediter. **For the purposes of a single prime contract, the single prime contractor shall be designated as the Project Expediter.**
- 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, and approved by the State Construction Office, in that order (Article 19).

- k. **Field Order**, as used herein, shall mean a written approval for the contractor to proceed with the work requested by owner prior to issuance of a formal Change Order. The field order shall be signed by the contractor, designer, owner, and State Construction Office.
- l. **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).
- m. **Liquidated damages**, as stated in the contract documents [, is an amount reasonably estimated in advance to cover the consequential damages associated with the Owner's economic loss in not being able to use the Project for its intended purposes at the end of the contract's completion date as amended by change order, if any, by reason of failure of the contractor(s) to complete the work within the time specified. Liquidated damages does not include the Owner's extended contract administration costs (including but not limited to additional fees for architectural and engineering services, testing services, inspection services, commissioning services, etc.), such other damages directly resulting from delays caused solely by the contractor, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the Contractor (e.g., if a multi-phased project-subsequent phases, delays in start other projects that are dependent on the completion of this Project, extension of leases and/or maintenance agreements for other facilities).
- n. **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.
- o. **Routine written communications between the Designer and the Contractor** are any communication other than a "request for information" provided in letter, memo, or transmittal format, sent by mail, courier, electronic mail, or facsimile. Such communications can not be identified as "request for information".
- p. **Clarification or Request for information (RFI)** is a request from the Contractor seeking an interpretation or clarification by the Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the Contractor's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- q. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work.
- r. **Inspection** shall mean examination or observation of work completed or in progress to determine its compliance with contract documents.
- s. **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents. Acceptance of equal is subject to approval of Designer and owner.
- t. **"Substitution" or "substitute"** shall mean materials, products, equipment, assemblies, or installation methods deviating in at least one characteristic (physical, functional, or aesthetic) from those specified, but which in the opinion of the bidder would improve competition and/or enhance the finished installation. Acceptance of substitution is subject to the approval of the Designer and owner.

- u. **Provide** shall mean furnish and install complete in place, new, clean, operational, and ready for use.
- v. **Indicated and shown** shall mean provide as detailed, or called for, and reasonably implied in the contract documents.
- w. **Special inspector** is one who inspects materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with the approved construction documents and referenced standards.
- x. **Commissioning** is a quality assurance process that verifies and documents that building components and systems operate in accordance to the owner's project requirements and the project design documents.
- y. **Designer Final Inspection** is the inspection performed by the design team to determine the completeness of the project in accordance with approved plans and specifications. This inspection occurs prior to SCO final inspection.
- z. **SCO Final Inspection** is the inspection performed by the State Construction Office to determine the completeness of the project in accordance with NC Building Codes and approved plans and specifications.
- aa. **Beneficial Occupancy** is requested by the owner and is occupancy or partial occupancy of the building after all life safety items have been completed as determined by the State Construction Office. Life safety items include but not limited to fire alarm, sprinkler, egress and exit lighting, fire rated walls, egress paths and security.
- bb. Final Acceptance is the date in which the State Construction Office accepts the construction as totally complete. This includes the SCO Final Inspection and certification by the designer that all punch lists are completed.

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other, and 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 bid for 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. The date of performance and payment bond shall not be prior to the date of 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 or Owner shall furnish free of charge to the contractors electronic copies of plans and specifications. If requested by the contractor, paper copies of plans and specifications shall be furnished free of charge as follows:

- a. General contractor - Up to twelve (12) sets of general contractor drawings and specifications, up to six (6) sets of which shall include drawings and specifications of all other contracts, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.

- b. Each other contractor - Up to six (6) sets of the appropriate drawings and specifications, up to three (3) sets of which shall include drawings and specifications of all other contracts, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.
- 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, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Within 15 consecutive calendar days after the notice to proceed, each prime contractor shall submit a schedule for submission of all shop drawings, product data, samples, and similar submittals through the Project Expediter to the Designer. This schedule shall indicate the items, relevant specification sections, other related submittal, data, and the date when these items will be furnished to the designer.
- b. The Contractor(s) shall review, approve and submit to the Designer all Shop Drawings, Coordination Drawings, Product Data, Samples, Color Charts, and similar submittal data required or reasonably implied by the Contract Documents. Required Submittals shall bear the Contractor's stamp of approval, any exceptions to the Contract Documents shall be noted on the submittals, and copies of all submittals shall be of sufficient quantity for the Designer to retain up to three (3) copies of each submittal for his own use plus additional copies as may be required by the Contractor. Submittals shall be presented to the Designer in accordance with the schedule submitted in paragraph (a). so as to cause no delay in the activities of the Owner or of separate Contractors.
- c. The Designer shall review required submittals promptly, noting desired corrections if any, and retaining three (3) copies (1 for the Designer, 1 for the owner and 1 for SCO) for his use. The remaining copies of each submittal shall be returned to the Contractor not later than twenty (20) days from the date of receipt by the Designer, for the Contractor's use or for corrections and resubmittal as noted by the Designer. When resubmittals are required, the submittal procedure shall be the same as for the original submittals.
- d. Approval of shop drawings/submittals 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 of 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, his authorized representative, owner or State Construction Office.

- 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 variations shall be fully noted on project drawings by the contractor and submitted to the designer upon project completion and no later than 30 days after final acceptance of the project.
- c. The contractor shall maintain at the job office a record of all required tests that have been performed, clearly indicating the scope of work inspected and the date of approval or rejection.

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. Request for substitution of materials, items, or equipment shall be submitted to the designer for approval or disapproval; such approval or disapproval shall be made by the designer prior to the opening of bids. Alternate materials may be requested after the award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and owner approves.
- e. 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 language, conduct, or attire 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 and included within the bid proposal. All water taps, meter barrels, vaults and impact fees shall be paid by the contractor unless otherwise noted.
- d. Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to inspection by any county or municipal authorities and are not subject to county or municipal building codes. The contractor shall, however, cooperate with the county or municipal authorities by obtaining building permits. Permits shall be obtained at no cost.
- e. Projects involving local funding (community colleges) are subject also to county and municipal building codes and inspection by local authorities. The contractor shall pay the cost of these permits and inspections.

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 damages caused to 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 and owner.
- 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 person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.
- 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(b).

- i. Any and all costs associated with correcting damage caused to adjacent properties of the construction site or staging area shall be borne by the contractor. These costs shall include but not be limited to flooding, mud, sand, stone, debris, and discharging of waste products.

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 and during any time work is in preparation and progress by the designer, designated official representatives of the owner, State Construction Office 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. All work shall be inspected by designer, special inspector and/or State Construction Office prior to being covered by the contractor. Contractor shall give a minimum two weeks notice unless otherwise agreed to by all parties. If inspection fails, after the first reinspection all costs associated with additional reinspections shall be borne by the contractor.

- d. 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.
- e. 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.
- f. Should any work be covered up or concealed prior to inspection and approval by the designer, special inspector, and/or State Construction Office such work shall be uncovered or exposed for inspection, if so requested by the designer in writing. Inspection of the work will be made 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.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

- a. Throughout the progress of the work, each contractor shall keep at the job site, a competent superintendent and supervisory staff satisfactory to the designer and the owner. The superintendent and supervisory staff shall not be changed without the consent of the designer and owner unless said superintendent ceases to be employed by the contractor or ceases to be competent as determined by the contractor, designer or owner. The superintendent and other staff designated by the contractor in writing 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, directions, instructions, and notices shall be confirmed in writing.
- 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. Prior to installation of work, all contractors shall jointly prepare coordination drawings, showing locations of various ductworks, piping, motors, pumps, and other mechanical or electrical equipment, in relation to the structure, walls and ceilings. These drawings shall be submitted to the designer through the Project Expediter for information only. Each contractor shall lay out and execute his work to cause the least delay to other contractors. Each contractor shall be financially responsible for any damage to other contractor's work and for undue delay caused to other contractors on the project.
- d. The contractor is required to attend 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. The contractor shall turn over a copy of his daily reports to the Designer and Owner at the job site progress conference. Owner will determine daily report format.

- e. The contractor(s) shall, employ an engineer or a land surveyor licensed in the State of North Carolina to lay out the work and to establish a bench mark 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. The Project Expediter shall have at a minimum the following responsibilities.
 - 1. Prepare the project construction schedule and shall allow all prime contractors (multi-prime contract) and subcontractors (single-prime contract) performing general, plumbing, HVAC, and electrical work equal input into the preparation of the initial construction schedule.
 - 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.
 - 5. Recommend to the owner whether payment to a contractor shall be approved.
- g. It shall be the responsibility of the Project Expediter to cooperate with and obtain from several prime contractors and subcontractors on the job, their respective work activities and integrate these activities into a project construction schedule in form of a detailed bar chart or Critical Path Method (CPM), schedule. Each prime contractor shall provide work activities within fourteen (14) days of request by the Project Expediter. A “work activity”, for scheduling purposes, shall be any component or contractual requirement of the project requiring at least one (1) day, but not more than fourteen (14) days, to complete or fulfill. The project construction schedule shall graphically show all salient features of the work required to construct the project from start to finish and within the allotted time established in the contract. The time (in days) between the contractor’s early completion and contractual completion dates is part of the project total float time; and shall be used as such, unless amended by a change order. On a multi-prime project, each prime contractor shall review the proposed construction schedule and approve same in writing. The Project Expediter shall submit the proposed construction schedule to the designer for comments. The complete Project construction schedule shall be of the type set forth in the Supplementary General Condition or subparagraph (1) or (2) below, as appropriate:

1. For a project with total contracts of \$500,000 or less, a bar chart schedule will satisfy the above requirement. The schedule shall indicate the estimated starting and completion dates for each major element of the work.
2. For a project with total contracts over \$500,000, a Critical Path Method (CPM) schedule shall be utilized to control the planning and scheduling of the Work. The CPM schedule shall be the responsibility of the Project Expediter and shall be paid for by the Project Expediter.

Bar Chart Schedule: Where a bar chart schedule is required, it shall be time-scaled in weekly increments, shall indicate the estimated starting and completion dates for each major element of the work by trade and by area, level, or zone, and shall schedule dates for all salient features, including but not limited to the placing of orders for materials, submission of shop drawings and other Submittals for approval, approval of shop drawings by designers, the manufacture and delivery of material, the testing and the installation of materials, supplies and equipment, and all Work activities to be performed by the Contractor. The Contractor shall allow sufficient time in his schedule for all commissioning, required inspections and completion of final punchlist(s). Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

CPM Schedule: Where a CPM schedule is required, it shall be in time-scaled precedence format using the Project Expediter's logic and time estimates. The CPM schedule shall be drawn or plotted with activities grouped or zoned by Work area or subcontract as opposed to a random (or scattered) format. The CPM schedule shall be time-scaled on a weekly basis and shall be drawn or plotted at a level of detail and logic which will schedule all salient features of the work to be performed by the Contractor. The Contractor shall allow sufficient time in his schedule for all commissioning, required inspections and completion of final punchlist(s).. Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

The CPM schedule will identify and describe each activity, state the duration of each activity, the calendar dates for the early and late start and the early and late finish of each activity, and clearly highlight all activities on the critical path. "Total float" and "free float" shall be indicated for all activities. Float time shall not be considered for the exclusive use or benefit of either the Owner or the Contractor, but must be allocated in the best interest of completing the Work within the Contract time. Extensions to the Contract time, when granted by Change Order, will be granted only when equitable time adjustment exceeds the Total Float in the activity or path of activities affected by the change. On contracts with a price over \$2,500,000, the CPM schedule shall also show what part of the Contract Price is attributable to each activity on the schedule, the sum of which for all activities shall equal the total Contract Price.

Early Completion of Project: The Contractor may attempt to complete the project prior to the Contract Completion Date. However, such planned early completion shall be for the Contractor's convenience only and shall not create any additional rights of the Contractor or obligations of the Owner under this Contract, nor shall it change the Time

for Completion or the Contract Completion Date. The Contractor shall not be required to pay liquidated damages to the Owner because of its failure to complete by its planned earlier date. Likewise, the Owner shall not pay the Contractor any additional compensation for early completion nor will the Owner owe the Contractor any compensation should the Owner, its officers, employees, or agents cause the Contractor not to complete earlier than the date required by the Contract Documents.

- h. The proposed project construction schedule shall be presented to the designer no later than fifteen (15) days after written notice to proceed. No application for payment will be processed until this schedule is accepted by the designer and owner.
- i. The approved project construction schedule shall be distributed to all contractors and displayed at the job site by the Project Expediter.
- j. The several contractors shall be responsible for their work activities and shall notify the Project Expediter of any necessary changes or adjustments to their work. The Project Expediter shall maintain the project construction schedule, making biweekly adjustments, updates, corrections, etc., that are necessary to finish the project within the Contract time, keeping all contractors and the designer fully informed. Copy of a bar chart schedule annotated to show the current progress shall be submitted by the Contractor(s) to the designer, along with monthly request for payment. For project requiring CPM schedule, the Contractor shall submit a biweekly report of the status of all activities. The bar chart schedule or status report shall show the actual Work completed to date in comparison with the original Work scheduled for all activities. If any activities of the work of several contractors are behind schedule, the contractor must indicate in writing, what measures will be taken to bring each such activity back on schedule and to ensure that the Contract Completion Date is not exceeded. A plan of action and recovery schedule shall be developed and submitted to the designer by the Project Expediter, when (1) the contractor's report indicates delays, that are in the opinion of the designer or the owner, of sufficient magnitude that the contractor's ability to complete the work by the scheduled completion is brought into question; (2) the updated construction schedule is thirty (30) days behind the planned or baseline schedule and no legitimate time extensions, as determined by the Designer, are in process; and (3) the contractor desires to make changes in the logic (sequencing of work) or the planned duration of future activities of the CPM schedule which, in the opinion of the designer or the owner, are of a major nature. The plan of action, when required shall be submitted to the Owner for review within two (2) business days of the Contractor receiving the Owner's written demand. The recovery schedule, when required, shall be submitted to the Owner within five (5) calendar days of the Contractor's receiving the Owner's written demand. Failure to provide an updated construction schedule or a recovery schedule may be grounds for rejection of payment applications or withholding of funds as set forth in Article 33.
- 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 determine the contractor(s) who caused the delays and notify the bonding company of the responsible contractor(s) of the delays; 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. The project expeditor's Superintendent(s) shall be in attendance at the Project site at all times when work is in progress unless conditions are beyond the control of the Contractor or until termination of the Contract in accordance with the Contract Documents. It is understood that such Superintendent shall be acceptable to the Owner and Designer and shall be the one who will be continued in that capacity for the duration of the project unless he ceases to be on the Contractor's payroll or the Owner otherwise agrees. The Superintendent shall not be employed on any other project for or by the Contractor or by any other entity during the course of the Work. If the Superintendent is employed by the Contractor on another project without the Owner's approval, then the Owner may deduct from the Contractor's monthly general condition costs and amount representing the Superintendent's cost and shall deduct that amount for each month thereafter until the Contractor has the Superintendent back on the Owner's Project full-time.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

- a. Effective from January 1, 2002, Chapter 143, Article 8, was amended, to allow public contracts to be delivered by the following delivery methods: single-prime, dual (single-prime and separate-prime), construction manager at risk, and alternative contracting method as approved by the State Building Commission. 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 State. For the purposes of a single prime contract, refer to Article 1 – Definitions.
- 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, openings, penetrations, 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 that are to be incorporated 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. The designer and the owner shall have access to the work whenever it is in preparation and progress and during normal working hours. The contractor shall provide facilities for such access so the designer may perform his functions under the contract documents.
- f. 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 thirty (30) days after award of the contract, the contractor shall submit to the designer, owner and to the State Construction Office 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 or owner, the designer or owner shall submit his reasons for disapproval in writing to the State Construction Office for its consideration with a copy to the contractor. If the State Construction Office concurs with the designer's or owner's recommendation, the contractor shall submit a substitute for approval. The designer and owner 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 or owner.
- 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. Funds for payment of such interest on state-owned projects shall be obtained from the current budget of the owning department, institution or agency. 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 direct work to be performed, to stop work, to order work removed, or to order corrections of faulty work, where any such action by the designer 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 and his consultants will make inspections of the project. 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 and owner may perform their 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 receipt of approved change order or written field order from the designer, countersigned by the owner and the state construction office authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed.

A field order, transmitted by fax, electronically, or hand delivered, may be used where the change involved impacts the critical path of the work. A formal change order shall be issued as expeditiously as possible.

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 specified by the designer or owner, 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.

- 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, or subsequently agreed to by the Contractor, Designer, Owner and State Construction Office 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, except in such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.
 - 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. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors (1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc)) shall be allowed a maximum of 10% on work they each self-perform; the prime contractor shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. ; 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 (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
1. The actual costs of materials and supplies incorporated or consumed as part of the work;
 2. The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they take place in an office or on the project site.
 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;
 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the work;
 5. The actual costs of premiums for bonds, insurance, permit fees, and sales or use taxes related to the work.

Overtime and extra pay for holidays and weekends may be a cost item only to the extent approved by the owner.

- f. 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 unit cost breakdown showing method of arriving at net cost as defined above.
- g. In all change orders, the procedure will be for the designer to request proposals for the change order work in writing. The contractor will provide such proposal and supporting data in suitable format. The designer shall verify correctness. Delay in the processing of the change order due to lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis of a claim. Within fourteen (14) days after receipt of the contractor's accepted proposal including all supporting documentation required by the designer, the designer shall prepare the change order and forward to the contractor for his signature or otherwise respond, in writing, to

the contractor's proposal. Within seven (7) days after receipt of the change order executed by the contractor, the designer shall, certify the change order by his signature, and forward the change order and all supporting data to the owner for the owner's signature. The owner shall execute the change order and forward to the State Construction Office for final approval, within seven (7) days of receipt. The State Construction Office shall act on the change order within seven (7) days. 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.

- h. 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."

- i. A change order, when issued, shall be full compensation, or credit, for the 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.
- j. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner, with the approval of the State Construction Office, may require the contractor to perform such work on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the Designer or owner, a correct account of cost together with all proper invoices, payrolls and supporting data. Upon completion of the work a change order will be prepared with allowances for overhead and profit per paragraph d. above and "net cost" and "cost" per paragraph e. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or to 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 instructions given 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. The written notice shall clearly state that a claim for extra cost is being made and shall provide a detailed justification for the extra cost. The contractor 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(b) and Article 11(h). No claims for extra compensation shall 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 shall 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. Should a claim for extra compensation that complies with the requirements of (a) above by the contractor and is denied by the designer or owner, and cannot be resolved by a

representative of the State Construction Office, the contractor may request a mediation in connection with GS 143-128(f1) in the dispute resolution rules adopted by the State Building Commission (1 N.C.A.C. 30H .0101 through .1001). If the contractor is unable to resolve its claim as a result of mediation, the contractor may pursue the claim in accordance with the provisions of G.S. 143-135.3, or G.S. 143-135.6 where Community Colleges are the owner, and the following:

1. A contractor who has not completed a contract with a board for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the director of the State Construction Office of the Department of Administration for the amount the contractor claims is due. The director may deny, allow or compromise the claim, in whole or in part. A claim under this subsection is not a contested case under Chapter 150B of the General Statutes.
2.
 - (a) A contractor who has completed a contract with a board for construction or repair work and who has not received the amount he claims is due under the contract may submit a verified written claim to the director of the State Construction Office of the Department of Administration for the amount the contractor claims is due. The claim shall be submitted within sixty (60) days after the contractor receives a final statement of the board's disposition of his claim and shall state the factual basis for the claim.
 - (b) The director shall investigate a submitted claim within ninety (90) days of receiving the claim, or within any longer time period upon which the director and the contractor agree. The contractor may appear before the director, either in person or through counsel, to present facts and arguments in support of his claim. The director may allow, deny or compromise the claim, in whole or in part. The director shall give the contractor a written statement of the director's decision on the contractor's claim.
 - (c) A contractor who is dissatisfied with the director's decision on a claim submitted under this subsection may commence a contested case on the claim under Chapter 150B of the General Statutes. The contested case shall be commenced within sixty (60) days of receiving the director's written statement of the decision.
 - (d) As to any portion of a claim that is denied by the director, the contractor may, in lieu of the procedures set forth in the preceding subsection of this section, within six (6) months of receipt of the director's final decision, institute a civil action for the sum he claims to be entitled to under the contract by filing a verified complaint and the issuance of a summons in the Superior Court of Wake County or in the superior court of any county where the work under the contract was performed. The procedure shall be the same as in all civil actions except that all issues shall be tried by the judge, without a jury.

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, copied to the State Construction Office, 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 of completion is stated in the Supplementary General Conditions and in the Form of Construction Contract. The Project Expediter, upon notice of award of contract, shall prepare a construction schedule to complete the project within the time of completion as required by Article 14.
- b. The contractors shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the designer and shall fully complete all work hereunder within the time of completion stated. Time is of the essence and the contractor acknowledges the Owner will likely suffer financial damage for failure to complete the work within the time of completion. 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. In the event of multiple prime contractors, 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 solely by any act or negligence of the owner, 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 only 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. No weather delays shall be considered after the building is dried in unless work claimed to be delayed is on the critical path of the baseline schedule or approved updated schedule. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any contractor claim for compensable damages for delays is limited to delays caused solely by the owner or its agents. Contractor caused delays shall be accounted for before owner or designer caused delays in the case of concurrent delays.

- e. Request for extension of time shall be made in writing to the designer, copies to the owner and SCO, within twenty (20) days following cause of delay. In case of continuing cause for delay, the Contractor shall notify the Designer to the designer, copies to the owner and SCO, of the delay within 20 days of the beginning of the delay and only one claim is necessary.
- f. The contractor shall notify his surety in writing of extension of time granted.
- g. No claim for time extension shall be allowed on account of failure of the designer to furnish drawings or instructions until twenty (20) days after demand for such drawings and/or instructions. See Article 5c. Demand must be in written form clearly stating the potential for delay unless the drawings or instructions are provided. Any delay granted will begin after the twenty (20) day demand period is concluded.

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

- a. The owner may desire to occupy or utilize all or a portion of the project prior to the completion of the project.
- b. Should the owner request a utilization of a building or portion thereof, the designer shall perform a designer final inspection of area after being notified by the contractor that the area is ready for such. After the contractor has completed designer final inspection punch list and the designer has verified, then the designer shall schedule a beneficial occupancy inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office. If beneficial occupancy is granted by the State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to support. in the area.
 - 2. The owner assumes all responsibilities for utility costs for entire building.
 - 2. Contractor will obtain consent of surety.
 - 3. Contractor will obtain endorsement from insurance company permitting beneficial 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, ACCEPTANCE, AND PROJECT CLOSEOUT

- a. Upon notification from the contractor(s) that the project is complete and ready for inspection, the designer shall make a Designer final inspection to verify that the project is complete and ready for SCO final inspection. Prior to SCO final inspection, the contractor(s) shall complete all items requiring corrective measures noted at the Designer

final inspection. The designer shall schedule a SCO final inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office.

- b. At the SCO final inspection, the designer and his consultants 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 SCO final inspection, the designer and State Construction Office representative shall make one of the following determinations:
 - 1. That the project is completed and accepted.
 - 2. That the project will be accepted subject to the correction of the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of SCO final inspection or the owner may invoke Article 28, Owner's Right to Do Work.
 - 4. That the project is not complete and another date for a SCO final inspection will be established.
- c. Within fourteen (14) days of final acceptance per Paragraph b1 or within fourteen (14) days after completion of punch list per Paragraph b2 above, the designer shall certify the work and issue applicable certificate(s) of compliance.
- d. Any discrepancies listed or discovered after the date of SCO final inspection and acceptance under Paragraphs b1 or b2 above shall be handled in accordance with Article 42, Guarantee.
- f. The final acceptance date 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.
- g. **Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide to the owner a complete instructional video (media format acceptable to the owner) on the operation, maintenance, care and adjustment of all equipment and special construction elements.**

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, as determined by the designer, 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. Contractor shall correct or make good any defects due thereto and repair any damage resulting there from, 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 seven (7) 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 seven (7) 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 seven (7) 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 forty-five (45) 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 10 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 contractor's work has been satisfactorily completed on schedule, with approval of the owner and the State Construction Office and written consent of the surety, further requirements for retainage will 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. The contractor(s) shall list the

value of each subcontractor and supplier, identifying each minority business subcontractor and supplier as listed in Affidavit C, if applicable.

- 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. Such payments will be made only for materials that have been customized or fabricated specifically for this project. Raw materials or commodity products including but not limited to piping, conduit, CMU, metal studs and gypsum board may not be submitted. 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 an independent, licensed, bonded warehouse approved by the designer, owner and the State Construction Office 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, owner and SCO 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, the owner and the State Construction Office prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State 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 State Construction Office 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 1/2) 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. Prior to submitting request for final payment to the designer for approval, the contractor shall fully comply with all requirements specified in the “project closeout” section of the specifications. These requirements include but not limited to the following:
 1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval from agencies having jurisdiction. (The designer must approve the Manuals prior to delivery to the owner).
 2. Transfer of Required attic stock material and all keys in an organized manner.
 3. Record of Owner’s training.
 4. Resolution of any final inspection discrepancies.
 5. Granting access to Contractor’s records, if Owner’s internal auditors have made a request for such access pursuant to Article 52.
- e. The contractor shall forward to the designer, the final application for payment along with the following documents:
 1. List of minority business subcontractors and material suppliers showing breakdown of contract amounts and total actual payments to subs and material suppliers.
 2. Affidavit of Release of Liens.
 3. Affidavit of contractors of payment to material suppliers and subcontractors. (See Article 36).
 4. Consent of Surety to Final Payment.
 5. Certificates of state agencies required by state law.
- f. The designer will not authorize final payment until the work under contract has been certified by designer, certificates of compliance issued, and the contractor has complied with the closeout requirements. The designer shall forward the contractor’s final application for payment to the owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

- a. The designer with the approval of the State Construction Office 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 secretary of the Department of Administration 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. The Owner may withhold all or a portion of Contractor's general conditions costs set forth in the approved schedule of values, if Contractor has failed to comply with: (1) a request to access its records by Owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14.j or provide The Owner; (3) a request to provide an electronic copies of Contractor's baseline schedule, updates with all logic used to create the schedules in the original format of the scheduling software; and (4) Contractor's failure to have its Superintendent on the Project full-time; (
 - d. 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 in accordance with G.S. 143-134.1. As provided in G.S.143-134.1(e) the owner shall not be liable for interest on payments withheld by the owner for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the owner or reasonable evidence that a third-party claim will be filed.

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 document that coverages afforded under the policies will not be cancelled, 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. If endorsements are needed to comply with the notification or other requirements of this article copies of the endorsements shall be submitted with the certificates.

a. Worker's Compensation and Employer's Liability

The contractor shall provide and maintain, until final acceptance, workmen'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, until final acceptance, 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

In lieu of limits listed above, a \$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 (Builder's Risk/Installation Floater)

The contractor shall purchase and maintain property insurance until final acceptance, 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 sub-subcontractors in the work and shall insure against the perils of fire, wind, rain, flood, 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.
- 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 owner 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 and owner's instructions regarding signs, advertisements, fires and smoking.
- d. No firearms, any type of alcoholic beverages, or drugs (other than those prescribed by a physician) will be permitted at the job site.

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 contractor shall provide necessary and adequate facilities for water, electricity, gas, oil, sewer and other utility services which maybe necessary and required for completion of the project including all utilities required for testing, cleaning, balancing, and sterilization of designated plumbing, mechanical and electrical systems. Any permanent meters installed shall be listed in the contractor's name until work has a final acceptance. The contractor will be solely responsible for all utility costs prior to final acceptance. Contractor shall contact all affected utility companies prior to bid to determine their requirements to provide temporary and permanent service and include all costs associated with providing those services in their bid. Coordination of the work of the utility companies during construction is the sole responsibility of the contractor.

- b. Meters shall be relisted in the owner's name on the day following final 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 charges 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. Prior to the operation of permanent systems, the Project Expediter will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.
- e. All contractors shall have the permanent building systems in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed and secured. 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 and secured when windows, doorways (exterior, mechanical, and electrical equipment rooms), and hardware are installed; and other openings have protection which will provide reasonable climatic control. The appropriate time to start the mechanical systems and climatic condition shall be jointly determined by the contractor(s), the designer and owner. Use of the equipment in this manner shall be subject to the approval of the Designer and owner and shall in no way affect the warranty requirements of the contractor(s).
- f. 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.
- g. 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.
- h. 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 final acceptance of work by the State Construction Office, each contractor shall remove and replace any parts of the permanent building systems damaged through use during construction.
 - 2. Temporary filters as recommended by the equipment manufacturer in order to keep the equipment and ductwork clean and free of dust and debris shall be installed in each of the heating and air conditioning units and at each return grille 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 and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.
 - 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.
- i. 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.
- j. 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.
- k. On multi-story construction projects, the Project Expediter shall provide temporary elevators, lifts, or other special equipment for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall be included in the Project Expediter's bid.
- l. 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

- a. The contractors shall keep the building and surrounding area reasonably free from rubbish at all times, and shall remove debris from the site on a timely basis or when directed to do so by the designer or Project Expediter. The Project Expediter shall provide an on site refuse container(s) for the use of all contractors. Each contractor shall remove their rubbish and debris from the building on a daily basis. The Project Expediter shall broom clean the building as required to minimize dust and dirt accumulation.
- b. The Project Expediter shall provide and maintain suitable all-weather access to the building.
- c. 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. 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 date of final acceptance of the work or beneficial occupancy and shall replace such defective materials or workmanship without cost to the owner.

- b. 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.
- 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 beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.
- d. Guarantees for roof, equipment, materials, and supplies shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

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 there from, 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

- a. Federal excise taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3442(3)).
- b. Federal transportation taxes do not apply to materials entering into state work (Internal Revenue Code, Section 3475(b) as amended).
- c. North Carolina sales tax and use tax, as required by law, do apply to materials entering into state work and such costs shall be included in the bid proposal and contract sum.
- d. Local option sales and use taxes, as required by law, do apply to materials entering into state work as applicable and such costs shall be included in the bid proposal and contract sum.
- e. **Accounting Procedures for Refund of County Sales & Use Tax**

Amount of county sales and use tax paid per contractor's statements:

Contractors performing contracts for state agencies shall give the state agency for whose project the property was purchased a signed statement containing the information listed in G.S. 105-164.14(e).

The Department of Revenue has agreed that in lieu of obtaining copies of sales receipts from contractors, an agency may obtain a certified statement as of April 1, 1991 from the contractor setting forth the date, the type of property and the cost of the property purchased from each vendor, the county in which the vendor made the sale and the amount of local sales and use taxes paid thereon. If the property was purchased out-of-state, the county in which the property was delivered should be listed. The contractor should also be notified that the certified statement may be subject to audit.

In the event the contractors make several purchases from the same vendor, such certified statement must indicate the invoice numbers, the inclusive dates of the invoices, the total amount of the invoices, the counties, and the county sales and use taxes paid thereon.

Name of taxing county: The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use.

When property is purchased from out-of-state vendors and the county tax is charged, the county should be identified where delivery is made when reporting the county tax.

Such statement must also include the cost of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the contractor.

Similar certified statements by his subcontractors must be obtained by the general contractor and furnished to the claimant.

Contractors are not to include any tax paid on supplies, tools and equipment which they use to perform their contracts and should include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure.

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 INDIVIDUALS WITH DISABILITIES

The contractor(s) agree not to discriminate against any employee or applicant for employment because of physical or mental disabilities 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 individuals with such disabilities without discrimination based upon their physical or mental disability in all employment practices.

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The State of North Carolina 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. The latest edition of *Guideline Criteria for Asbestos Abatement* from the State Construction Office is to be incorporated in all asbestos abatement projects for the Capital Improvement Program.

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

GS 143-128.2 establishes a ten percent (10%) goal for participation by minority businesses in total value of work for each State building project. The document, *Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts* including Affidavits and Appendix E are hereby incorporated into and made a part of this contract.

ARTICLE 50 – CONTRACTOR EVALUATION

The contractor's overall work performance on the project shall be fairly evaluated in accordance with the State Building Commission policy and procedures, for determining qualifications to bid on future State capital improvement projects. In addition to final evaluation, interim evaluation may be prepared during the progress of project. The document, Contractor Evaluation Procedures, is hereby incorporated and made a part of this contract. The owner may request the contractor's comments to evaluate the designer.

ARTICLE 51 – GIFTS

Pursuant to N.C. Gen. Stat. § 133-32, it is unlawful for any vendor or contractor (i.e. architect, bidder, contractor, construction manager, design professional, engineer, subcontractor, supplier, vendor, etc.), to make gifts or to give favors to any State employee. This prohibition covers those vendors and contractors who: (1) have a contract with a governmental agency; or (2) have performed under such a contract within the past year; or (3) anticipate bidding on such a contract in the future. For additional information regarding the specific requirements and exemptions, vendors and contractors are encouraged to review G.S. Sec. 133-32.

During the construction of the Project, the Contractor is prohibited from making gifts to any of the Owner's employees, Owner's project representatives (architect, engineers, construction manager and their employees), employees of the State Construction Office and/or any other State employee that may have any involvement, influence, responsibilities, oversight, management and/or duties that pertain to and/or relate to the contract administration, financial administration and/or disposition of claims arising from and/or relating to the Contract and/or Project.

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

In accordance with N.C. General Statute 147-64.7, the State Auditor shall have access to Contractor's officers, employees, agents and/or other persons in control of and/or responsible for the Contractor's records that relate to this Contracts for purposes of conducting audits under the referenced statute. The Owner's internal auditors shall also have the right to access and copy the Contractor's records relating to the Contract and Project during the term of the Contract and within two years following the completion of the Project/close-out of the Contract to verify accounts, accuracy, information, calculations and/or data affecting and/or

relating to Contractor's requests for payment, requests for change orders, change orders, claims for extra work, requests for time extensions and related claims for delay/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, and/or any other type of claim for payment or damages from Owner and/or its project representatives.

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

The North Carolina False Claims Act ("NCFCA"), N.C Gen. Stat. § 1-605 through 1-618, applies to this Contract. The Contractor should familiarize itself with the entire NCFCA and should seek the assistance of an attorney if it has any questions regarding the NCFCA and its applicability to any requests, demands and/or claims for payment its submits to the State through the contracting state agency, institution, university or community college.

The purpose of the NCFCA "is to deter persons from knowingly causing or assisting in causing the State to pay claims that are false or fraudulent and to provide remedies in the form of treble damages and civil penalties when money is obtained from the State by reason of a false or fraudulent claim." (Section 1-605(b).) A contractor's liability under the NCFCA may arise from, but is not limited to: requests for payment, invoices, billing, claims for extra work, requests for change orders, requests for time extensions, claims for delay damages/extended general conditions costs, claims for lost productivity, claims for loss efficiency, claims for idle equipment or labor, claims for price/cost escalation, pass-through claims of subcontractors and/or suppliers, documentation used to support any of the foregoing requests or claims, and/or any other request for payment from the State through the contracting state agency, institution, university or community college. The parts of the NCFCA that are most likely to be enforced with respect to this type of contract are as follows:

- A "claim" is "[a]ny request or demand, whether under a contract or otherwise, for money or property and whether or not the State has title to the money or property that (i) is presented to an officer, employee, or agent of the State or (ii) is made to a contractor ... if the money or property is to be spent or used on the State's behalf or to advance a State program or interest and if the State government: (a) provides or has provided any portion of the money or property that is requested or demanded; or (b) will reimburse such contractor ... for any portion of the money or property which is requested or demanded." (Section 1-606(2).)
- "Knowing" and "knowingly." – Whenever a person, with respect to information, does any of the following: (a) Has actual knowledge of the information; (b) Acts in deliberate ignorance of the truth or falsity of the information; and/or (c) Acts in reckless disregard of the truth or falsity of the information. (Section 1-606(4).) Proof of specific intent to defraud is not required. (Section 1-606(4).)
- "Material" means having a natural tendency to influence, or be capable of influencing, the payment or receipt of money or property. (Section 1-606(4).)
- Liability. – "Any person who commits any of the following acts shall be liable to the State for three times the amount of damages that the State sustains because of the act of that person[:]" ... (1) Knowingly presents or causes to be presented a false or fraudulent claim for payment or approval. (2) Knowingly makes, uses, or causes to be made or used, a false record or statement material to a false or fraudulent claim. (3) Conspires to commit a violation of subdivision (1), (2) ..." (Section 1-607(a)(1), (2).)

- The NCFCA shall be interpreted and construed so as to be consistent with the federal False Claims Act, 31 U.S.C. § 3729, et seq., and any subsequent amendments to that act. (Section 1-616(c).)

Finally, the contracting state agency, institution, university or community college may refer any suspected violation of the NCFCA by the Contractor to the Attorney General's Office for investigation. Under Section 1-608(a), the Attorney General is responsible for investigating any violation of NCFCA, and may bring a civil action against the Contractor under the NCFCA. The Attorney General's investigation and any civil action relating thereto are independent and not subject to any dispute resolution provision set forth in this Contract. (See Section 1-608(a).)

ARTICLE 54 – TERMINATION FOR CONVENIENCE

Owner may at any time and for any reason terminate Contractor's services and work at Owner's convenience. Upon receipt of such notice, Contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement.

Upon such termination, Contractor shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by Contractor as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit. There shall be deducted from such sums as provided in this subparagraph the amount of any payments made to Contractor prior to the date of the termination of this Agreement. Contractor shall not be entitled to any claim or claim of lien against Owner for any additional compensation or damages in the event of such termination and payment.

SUPPLEMENTARY GENERAL CONDITIONS (SGC's)

1. TIME OF COMPLETION/LIQUIDATED DAMAGES

The Contractor shall commence work to be performed under this Contract on the date to be specified in the Notice to Proceed from the Contract Administrator and shall fully complete all work hereunder **within 245 consecutive calendar days from date of Notice to Proceed with work on site fully complete by August 7, 2026.**

For each day in excess of the above number of days, the Contractor(s) shall pay the Owner liquidated damages in the amount of \$500 per consecutive calendar day.

If the Contractor is delayed at any time in the progress of the Contractor's work by any act or negligence of the Owner, the Owner's employees or the Owner's separate Contractor; by changes ordered in the work; by abnormal weather conditions; by any causes beyond the Contractor's control; or by other causes deemed justifiable by Owner, then the contract time may be reasonably extended in a written order from the Owner upon written request from the Contractor within ten (10) days following the cause for delay.

2. CONSTRUCTION SCHEDULE

The Contractor shall start work within two (2) weeks upon receipt of Notice to Proceed and have shop drawings completed for material orders required in order to meet the project completion date. The Contractor shall submit a project work schedule before beginning work. The starting date and work schedule shall be adhered to, and the work shall be performed during the Owner's normal working hours, 8:00am to 5:00pm. Requests by the Contractor to work outside normal working hours shall be made a minimum of one (1) week in advance to the School. The Contractor's bid shall include all costs associated with workers working outside of normal business hours and/or costs associated with workers working overtime as required to meet the specified project schedule. The Owner reserves the right to request work to be performed outside normal working hours and to limit Contractor activities when they conflict with Owner operations. Any increased costs due to Owner requirements for work outside normal hours not specified in the Contract Documents will be negotiated.

3. UTILITIES

The Owner will provide water and electricity to the extent they are available at the project site.

The Contractor shall provide restroom facilities adjacent to Hunt Residence Mechanical Room Entrance. The Contractor's personnel shall not use toilet or washroom facilities in the existing building.

The Contractor shall be responsible for procedures for making temporary disruptions to existing utilities serving the building, and roads and pedestrian walks shall be planned well in advance of the work and the work shall be executed in a manner to provide reasonably continuous service throughout the construction period. Interruptions of service shall be coordinated with the Contract Administrator at least seven (7) days in advance.

4. SECURITY

Contractor shall coordinate security requirements with the School.

5. USE OF SITE

Work under this contract shall be performed in such a manner as to avoid interruption or interference with the operation of any existing activity on the premises or at the location of the work. The Owner may enforce extra restrictions during certain periods of the year. During examination periods, the Contractor shall restrict noise-making activities. If the project involves work in or near a building in which an exam is being conducted, the Contractor shall be required to restrict operations which are disturbing to students during the hours of the exam(s). Work will not be permitted on Graduation Day, or the day preceding it (Saturday).

While on campus, Contractor's and Sub-Contractor's personnel shall be identifiable at all times, for example, by wearing company names or logos on garments or hard hats.

This is a smoke-free campus, including vaping and other e-cigarette devices. Contractor shall not smoke or vape anywhere on campus.

Damage done to the University premises that are under the control of the Contractor, or damage caused by the contractor to premises used by the contractor, shall be corrected at the Contractor's expense.

The contractor shall schedule deliveries between 8:00am and 4:00pm. The contractor shall notify the School of any deliveries of equipment, material or road work that will impede the flow of vehicular or pedestrian traffic. The contractor shall provide traffic control by certified traffic control personnel (vehicular and pedestrian) during these deliveries. Staging for multiple concrete / steel / other large material deliveries, crane and other large pieces of equipment must be coordinated with the School. Walks, streets, and drives are most congested with pedestrians at the top of the hour, when making deliveries the carrier should be made aware of this and plan his deliveries accordingly.

Roads, streets, drives, fire lanes must remain open at all times. Adequate clearance must be maintained for emergency vehicles to negotiate the drive. Maintain a minimum of 20 feet for fire lanes. Construction vehicles are not allowed to block, park, or stage in a fire lanes. Vehicles blocking fire lanes will be ticketed and towed at the Contractor's expense.

Construction fences (if required) shall be chain link with sandbag secured footings and shall be covered with fabric screening unless it blocks the view of oncoming traffic and is approved by the Engineer and Owner in advance. Construction gates will swing into the construction area. The construction fences should not obstruct pedestrian or vehicle traffic.

The Contractor will provide additional cleanup and warning signs and barricades if deemed necessary by the Owner.

The Contractor's scheduling and staging requirements must be coordinated with, and approved by, the School. Lay down areas will be confined to mechanical rooms. If the contractor requires additional lay-down storage areas, these will need to be located adjacent to Hunt Residence Hall parking areas and contractor will be required to provide construction fencing as noted above. 2 vehicles will be permitted to park adjacent to Hunt and all remaining vehicles park in main visitor lot adjacent to Bryan Center entrance.

The work shall be performed during the Owner's normal working hours, 8:00am to 5:00pm, Monday to Friday. Requests by the Contractor to work outside normal working hours shall be made in advance to the School. The Contractor's bid shall include all costs associated with workers working

outside of normal business hours and/or costs associated with workers working overtime as required to meet specified project schedule. The Owner reserves the right to request work to be performed outside normal working hours and to limit contractor activities when they conflict with Owner operations. Any increased costs due to Owner requirements for work outside normal hours not specified in the Contract Documents will be negotiated.

GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS

In accordance with G.S. 143-128.2 (effective January 1, 2002) these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, and alternative contracting methods, on State construction projects in the amount of \$300,000 or more. The legislation provides that the State shall have a verifiable ten percent (10%) goal for participation by minority businesses in the total value of work for each project for which a contract or contracts are awarded. These requirements are published to accomplish that end.

SECTION A: INTENT

It is the intent of these guidelines that the State of North Carolina, 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 ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 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 B: 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, 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 governmental units.
5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.
6. Designer - Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina 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 the State of North Carolina 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 his subcontract.

SECTION C: RESPONSIBILITIES

1. Office for Historically Underutilized Businesses, Department of Administration (hereinafter referred to as HUB Office).

The HUB Office has established a program, which allows interested persons or businesses qualifying as a minority business under G.S. 143-128.2, to obtain certification in the State of North Carolina procurement system. The information provided by the minority businesses will be used by the HUB Office to:

- a. Identify those areas of work for which there are minority businesses, as requested.
- b. Make available to interested parties a list of prospective minority business contractors and subcontractors.
- c. Assist in the determination of technical assistance needed by minority business contractors.

In addition to being responsible for the certification/verification of minority businesses that want to participate in the State construction program, the HUB Office will:

- (1) Maintain a current list of minority businesses. The list shall include the areas of work in which each minority business is interested.
- (2) Inform minority businesses on how to identify and obtain contracting and subcontracting opportunities through the State Construction Office and other public entities.
- (3) Inform minority businesses of the contracting and subcontracting process for public construction building projects.
- (4) Work with the North Carolina trade and professional organizations to improve the ability of minority businesses to compete in the State construction projects.
- (5) The HUB Office also oversees the minority business program by:
 - a. Monitoring compliance with the program requirements.
 - b. Assisting in the implementation of training and technical assistance programs.
 - c. Identifying and implementing outreach efforts to increase the utilization of minority businesses.
 - d. Reporting the results of minority business utilization to the Secretary of the Department of Administration, the Governor, and the General Assembly.

2. State Construction Office

The State Construction Office will be responsible for the following:

- a. Furnish to the HUB Office a minimum of twenty-one days prior to the bid opening the following:
 - (1) Project description and location;
 - (2) Locations where bidding documents may be reviewed;
 - (3) Name of a representative of the owner who can be contacted during the advertising period to advise who the prospective bidders are;
 - (4) Date, time and location of the bid opening.
 - (5) Date, time and location of prebid conference, if scheduled.
- b. Attending scheduled prebid conference, if necessary, to clarify requirements of the general statutes regarding minority-business participation, including the bidders' responsibilities.

- c. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal, that must be complied with, if the bid is to be considered as responsive, prior to award of contracts. The State reserves the right to reject any or all bids and to waive informalities.
- d. Reviewing of minority business requirements at Preconstruction conference.
- e. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
- f. Provide statistical data and required reports to the HUB Office.
- g. Resolve any protest and disputes arising after implementation of the plan, in conjunction with the HUB Office.

3. Owner

Before awarding a contract, owner shall do the following:

- a. Develop and implement a minority business participation outreach plan to identify minority businesses that can perform public building projects and to implement outreach efforts to encourage minority business participation in these projects to include education, recruitment, and interaction between minority businesses and non-minority businesses.
- b. Attend the scheduled prebid conference.
- c. At least 10 days prior to the scheduled day of bid opening, notify minority businesses that have requested notices from the public entity for public construction or repair work and minority businesses that otherwise indicated to the Office for Historically Underutilized Businesses an interest in the type of work being bid or the potential contracting opportunities listed in the proposal. The notification shall include the following:
 - 1. A description of the work for which the bid is being solicited.
 - 2. The date, time, and location where bids are to be submitted.
 - 3. The name of the individual within the owner's organization who will be available to answer questions about the project.
 - 4. Where bid documents may be reviewed.
 - 5. Any special requirements that may exist.
- d. Utilize other media, as appropriate, likely to inform potential minority businesses of the bid being sought.
- e. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- f. Review, jointly with the designer, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total 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 award to the State Construction Office.
- g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to State Construction Office.
- h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
- i. Make documentation showing evidence of implementation of Owner's responsibilities available for review by State Construction Office and HUB Office, upon request

4. Designer

Under the single-prime bidding, separate prime bidding, construction manager at risk, or alternative contracting method, the designer will:

- a. Attend the scheduled prebid conference to explain minority business requirements to the prospective bidders.
- b. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential contracting opportunities.
- c. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- d. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S.143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with

corresponding total 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 award.

- e. During construction phase of the project, review “MBE Documentation for Contract Payment” – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the owner and forward copies to the State Construction Office.
- f. Make documentation showing evidence of implementation of Designer’s responsibilities available for review by State Construction Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, and Its First-Tier Subcontractors

Under the single-prime bidding, the separate-prime bidding, construction manager at risk and alternative contracting methods, contractor(s) will:

- a. Attend the scheduled prebid conference.
- b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
- c. 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 will include the following:
 - (1) A description of the work for which the subbid is being solicited.
 - (2) The date, time and location where subbids are to be submitted.
 - (3) The name of the individual within the company who will be available to answer questions about the project.
 - (4) Where bid documents may be reviewed.
 - (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

If there are more than three (3) minority businesses in the general locality of the project who offer similar contracting or subcontracting services in the specific trade, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.

- d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
- e. 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).
- f. Make documentation showing evidence of implementation of PM, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
- g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) 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; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
- h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
- i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), “MBE Documentation for Contract Payment” – (Appendix E), for designer’s review.
- j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office 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.

- k. If during the construction of a project additional subcontracting opportunities become available, make a good faith effort to solicit subbids from minority businesses.
- l. It is the intent of these requirements apply to all contractors performing as prime contractor and first tier subcontractor under construction manager at risk on state projects.

6. Minority Business Responsibilities

While minority businesses are not required to become certified in order to participate in the State construction projects, it is recommended that they become certified and should take advantage of the appropriate technical assistance that is made available. In addition, minority businesses who are contacted by owners or bidders must respond promptly whether or not they wish to submit a bid.

SECTION 4: DISPUTE PROCEDURES

It is the policy of this state that disputes that involves a person's rights, duties or privileges, should be settled through informal procedures. To that end, minority business disputes arising under these guidelines should be resolved as governed under G.S. 143-128(g).

SECTION 5: These guidelines shall apply upon promulgation on state construction projects. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: www.nc-sco.com

SECTION 6: In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing minority business participation in the state construction program.

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: <http://www.nc-sco.com>

MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts **or** affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, 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.

OR

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

OR

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also 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 the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

- (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.
- (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.
- (3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.
- (4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- (5) Attending any prebid meetings scheduled by the public owner.
- (6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.
- (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.
- (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.
- (9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- (10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: _____ Approved/Certified By: _____

Name

Title

Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

DIVISION 01 – GENERAL REQUIREMENTS
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Raleigh, North Carolina 27612
919-233-8091
NC License # F1222

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Access to site.
 - 4. Coordination with occupants.
 - 5. Work restrictions.
 - 6. Specification and drawing conventions.
 - 7. Roof Warranty Information

1.2 PROJECT INFORMATION

- A. Project Identification: NC School of Science and Mathematics Campus-Wide HVAC Renovations
- B. Project Location: 1219 Board Street, Durham, NC
- C. Owner: NC School of Science and Mathematics
- D. MEP Engineers: McKim & Creed, 4300 Edwards Mill Rd., Suite 200, Raleigh, NC 27612

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents.

1.4 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to area indicated on Drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Sidewalks shall maintain ADA accessibility.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 1. Notify Owner not less than seven days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than seven days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- E. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- F. Employee Identification: Owner will provide identification tags per badging process for Contractor personnel working on Project site. Require personnel to use identification tags at all times per contractor requirements.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall include in the base Contract Sum the following allowances. Unless otherwise indicated, the allowance shall include all costs for labor, material, taxes, overhead, profit, fees and associated costs. The Contract sum shall be adjusted when the actual cost of work is determined by Change Order issued by the Architect/Engineer in accordance with the Supplementary General Conditions. Unit Prices, indicated on the Form of Proposal, shall be used as a basis to calculate adjustments to the contract amount. The unused portion of all allowances shall be credited to the Owner at the completion of the work.
- B. Refer to Section 01 22 00 "Unit Prices" for descriptions of unit prices referenced in this section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. Allowances #1 and #2: Allowances are as follows for the removal of asbestos-containing materials associated with the Project Scope of Work:
 - 1. Allowance #1: Replacement of existing VCT flooring adjacent to floor grilles: 200 SF (square feet)
 - 2. Allowance #2: Repair of existing fire rated penetrations in fire rated assemblies: 200 SF (square feet)

END OF SECTION

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. See Division 1 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.

1.2 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- No. 1: Provide a price per square foot of replacement of existing vinyl coated tile (VCT) flooring (specific to areas where floor grilles are being replaced). VCT shall match current finishes in the building. Refer to Section 01 21 00 "Allowances" for estimated quantities.

- No. 2: Provide a price per square foot to repair existing penetrations in fire rated assemblies (shall include floors and walls). Repairs shall be provided in accordance with UL details. Refer to Section 01 21 00 "Allowances" for estimated quantities.

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 specification sections, apply to work of this section.

1.2 SUMMARY

This section specifies administrative and procedural requirements for Alternates.

- A. GENERAL NOTE: The drawings generally indicate the work which will be included if the alternate bids are accepted. These portions of the work described in the alternates will not be included in the base bid.
- B. Definition: An Alternate is an amount proposed by Bidders and stated on the Bid form for certain construction activities defined in the Bidding Requirements that may be added to the Base bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems or installation methods described in Contract Documents.
- C. Coordination: Coordinate related Work and modify or adjust adjacent work as necessary to ensure that Work affected by each accepted alternate is complete and fully integrated into the project.
- D. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved notification of the status of each alternate. Indicate whether alternates have been accepted, rejected, modified or deferred for consideration at a later date. Include a complete description of negotiated modifications to alternates and other contract documents. Record this information on the project set of drawings in the job site construction trailer.
- E. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the Work described under each alternate.
- a. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the alternate.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

SCHEDULE OF ALTERNATES

- ALT-M1 - Resident Terminal Units: Remove and replace existing VAV and FCU terminal units serving Resident rooms. Include replacement of all associated supply air grilles and thermostats.
- ALT-M2 - Other Terminal Units: Remove and replace existing VAV terminal units serving common areas and corridors. Include replacement of all associated supply air grilles and thermostats.
- ALT-M3 - Provide BACnet based building automation system by Trane controls as preferred brand alternate.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 2. Section 017839 "Project Record Document" for submitting record drawings and record specifications and record product data.

1.2 SUBMITTAL REQUIREMENTS

- A. Shop Drawings:
 - 1. Prepare drawings in a clear and thorough manner.
 - 2. Identify details by reference to sheet and detail, schedule or room numbers on the Contract Drawings.
- B. Product Data:
 - 1. Preparation:
 - a. Clearly mark each copy to identify pertinent products or models.
 - b. Show performance characteristics and capacities.
 - c. Show dimensions and clearances required.
 - d. Show wiring diagrams and controls where applicable.
 - 2. Manufacturer's standard schematic drawings and diagrams:
 - a. Delete information from drawings and diagrams which is not applicable to the Work.
 - b. Supplement standard information to provide information specific to the Work.
- C. Samples: Provide samples of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture and pattern.

1.3 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work.
- B. Number of submittals required:
 - 1. Shop Drawings: Submit one (1) electronic copy of each shop drawing or similar document. Submit one additional copy of Shop Drawings that require review by Architect's consultants.
 - 2. Product Data: Submit one (1) electronic copy. Submit additional copies on Products that require review by Architect's consultants.

3. Material Samples: Unless otherwise specified, submit physical copy in triplicate.

C. Submittal Contents:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. Contract identification.
4. The names of:
 - a. Supplier/Subcontractor
 - b. Manufacturer
5. Identification of the product, with the specification section number.
6. Clearly identify field dimensions.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM or Federal Specification Numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. Contractor's stamp, initialed or signed, certifying his review of submittal in accordance with requirements of the General Conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

3.2 ENGINEER/ARCHITECT ACTION

- A. The Engineer or Architect will stamp each submittal to be returned with a uniform, self-explanatory action stamp, appropriately marked and executed to indicate the status of the submittal.
- B. The Engineer or Architect will endeavor to take action and process submittals with reasonable speed so as not to delay the progress of the work. However, the Contractor shall allow sufficient time for handling for proper review and resubmittal, if required.

3.3 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by the Engineer or Architect and resubmit, as specified for initial submittals, until approved.

3.4 DISTRIBUTION

- A. Distribute approved reproductions of Shop Drawings and copies of Product Data to:
 1. Job Site
 2. Affected Trade Contractors
 3. Consultant, when applicable.

- B. Copy all transmittals to Owner's Representative.

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements of the Contract Documents concerning "substitutions" for proposal of comparable product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Final cleaning.
 - 2. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Construction Waste Disposal: Comply with waste disposal requirements in compliance with local requirements.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace damaged construction. Repairing includes refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. Four paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: 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 and contact information for Contractor.
 - 6. Name and contact information for Architect.

7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 1. Binders: Heavy-duty, three-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. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. 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 of the manual. 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 storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.

5. 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.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.

3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in 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 and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in 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 and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit three sets of marked-up record prints.
- B. Record Specifications: Submit three paper copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one paper copy of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.

- c. Revisions to routing of piping and conduits.
 - d. Revisions to electrical circuitry.
 - e. Actual equipment locations.
 - f. Duct size and routing.
 - g. Locations of concealed internal utilities.
 - h. Changes made by Change Order or Construction Change Directive.
 - i. Changes made following Architect's written orders.
 - j. Details not on the original Contract Drawings.
 - k. Field records for variable and concealed conditions.
 - l. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

END OF SECTION

DIVISION 21 – FIRE PROTECTION SPECIFICATIONS
TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
21 05 01	COMMON WORK RESULTS FOR FIRE SUPPRESSION
21 05 02	FIRE PROTECTION SHOP DRAWINGS AND SUBMITTALS, SUBSTITUTIONS AND O&M MANUALS
21 05 53	IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT
21 11 01	FIRE PROTECTION PIPING
21 11 04	HANGERS AND SUPPORTS FOR FIRE PROTECTION SYSTEMS
21 23 13	WET-PIPE SPRINKLER SYSTEMS



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SECTION 21 05 01- COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt, and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.
- D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

- A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of Divisions 21 with work of other trades and provide a complete and fully functional installation.
- B. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- C. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and this Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- D. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
- E. Division 21 Contractor shall furnish all motor starters and disconnect switches as required by NEC for motors, unless specifically noted otherwise in the specifications or on the drawings. Motor starters and disconnect switches shall be in accordance with Division 26 Specifications.
- F. If a Guaranteed Maximum Price (GMP) has been prepared using documents prior to the issuance of the 100% Bid Documents, the Contractor shall identify any and all changes to the documents (both drawings and specifications) that are affecting the GMP, either increasing or

GMP amount. All changes shall be numbered and circled, in both drawings and specifications. The Contractor shall also provide detailed cost back-up for all items noted above.

- G. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the fire protection systems. The work shall consist of but shall not necessarily be limited to the following:
 - 1. Automatic wet pipe sprinkler systems in the buildings as indicated, including hydraulic calculations.
 - 2. Wet pipe automatic sprinkler systems as specified in Section 21 23 13.
 - 3. Piping materials and installation instructions common to most piping systems.
- H. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- I. Nothing herein shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of the drawings and specifications. He will be held to provide and install all materials and equipment, and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. Also he is responsible for properly coordinating his work with all other trades.
- J. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.
- K. The Contractor shall affix the seal of the registered professional engineer or the NICET Level III designer to all submitted system drawings and hydraulic calculations as required by the State of North Carolina General Statutes.
- L. Related Sections:
 - 1. Division 09 - Painting and Coating

1.3 DEFINITIONS AS USED IN THESE SPECIFICATIONS

- A. "Provide," means "furnish and install."
- B. "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support."
- C. "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."
- D. "Architect" means the "Prime Design Consultant," and if United Engineering Group, Inc. is not the prime design consultant, the Architect may authorize United Engineering Group to act on the Architect's behalf in matters concerning the Division 21 series of specifications.
- E. "RFI" means Contractor's "Request for Information."
- F. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- G. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- H. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- I. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- J. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- K. The following are industry abbreviations for plastic materials:
 - 1. Retain abbreviations that remain after this Section has been edited.
 - 2. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 3. CPVC: Chlorinated polyvinyl chloride plastic.
 - 4. PE: Polyethylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- L. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 CONTRACT DOCUMENTS

- A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Division 21 must be coordinated.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.
- D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- E. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.
- F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.5 DISCREPANCIES IN DOCUMENTS

- A. Where Drawings or Specifications conflict or are ambiguous, the contractor shall advise the Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.
- B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.
- C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.
- D. It is a requirement of these Contract Documents to have the contractor provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Architect shall review and advise the contractor of the disposition.

1.6 MODIFICATIONS IN LAYOUT

- A. Fire Protection Drawings are diagrammatic. They indicate general arrangements of fire suppression systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. In order to obtain the Architect's desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels) review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- C. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Divisions 21 will be installed.
- D. Maintain maximum headroom at all locations. All piping, duct, conduit and associated components to be as tight to underside of structure as possible.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C and D above. Systems shall be run in a rectilinear fashion.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 REQUESTS FOR INFORMATION (RFI'S)

- A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.5 (E) and 1.6 (F) above.

- B. To expedite the flow of RFI's, for all RFI's under Divisions 21, Contractor shall submit the attached form, or similar form including the same information, to the Architect, with copy to United Engineering Group. Contractor shall include proposed solution in the indicated space on the form.

1.8 REFERENCES

- A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition as adopted by the authority having jurisdiction. The publications are referred to in the text as necessary. The minimum standard of work under this contract shall be in accordance with the following model building codes and standards:
 - 1. North Carolina State Building Codes:
 - a. Building Code – 2021 edition
 - b. Fire Prevention Code – 2021 edition
 - 2. National Fire Protection Association
 - a. NFPA 13 - Standard for the Installation of Sprinkler Systems.
 - b. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
 - c. NFPA 20 - Standard for the Installation of Centrifugal Fire Pumps.
 - d. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 - e. NFPA 70 - National Electrical Code
- C. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- D. Air Movement and Control Association International, Inc.:
 - 1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- E. American National Standards Institute (ANSI):
 - 1. ANSI A21.4 / AWWA C104 – Cement Mortar Lining for Ductile-Iron Pipe
 - 2. ANSI A21.11 / AWWA C111 – Rubber Gasket Joints for Ductile-Iron Pipe
 - 3. ANSI A21.51 / AWWA C151 – Ductile-Iron Pipe
 - 4. ANSI B16.4 – Cast Iron Screwed Fittings
 - 5. ANSI B16.12 – Cast Iron Drainage Fittings, Threaded
 - 6. ANSI B16.15 – Pipe Fittings, Bronze, and 250 lb. Cast
 - 7. ANSI B16.18 – Cast Copper Allow Solder-Joint Pressure Fittings
 - 8. ANSI B16.22 – Solder-Joint Fittings, Pressure Wrought Copper and Copper Alloy

9. ANSI B16.23 – Cast Copper Alloy Solder-Joint Drainage Fittings
 10. ANSI B16.24 – Bronze Pipe Flanges and Flanged Fittings
 11. ANSI B16.29 - Solder-joint fittings, Drainage, DWV Wrought Copper and Copper Alloy
 12. ANSI S1.4 - Sound Level Meters.
 13. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 14. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 15. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- F. Air-Conditioning and Refrigeration Institute:
1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
- G. American Society of Heating, Refrigerating and:
1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 2. ASHRAE Handbook - HVAC Applications.
- H. American Society of Mechanical Engineers (ASME):
1. ASME A13.1 - Scheme for the Identification of Piping Systems.
 2. ASME B31.9 - Building Services Piping.
 3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 4. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
 5. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 6. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 7. ASME B16.25 – Butt-welding Ends.
 8. ASME B16.3 - Malleable Iron Threaded Fittings.
 9. ASME B16.4 - Gray Iron Threaded Fittings.
 10. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 11. ASME B16.9 - Factory-Made Wrought Steel Butt-welding Fittings.
 12. ASME B31.1 - Power Piping.
 13. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
 14. ASME B40.1 - Gages - Pressure Indicating Dial Type - Elastic Element.
 15. ASME - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels.
 16. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- I. American Society of Testing and Materials (ASTM) International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A106 - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 3. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
 4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 5. ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 6. ASTM B32 - Standard Specification for Solder Metal.
 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 8. ASTM B247 - Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 9. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
 11. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 12. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 13. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 14. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 15. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures
 16. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
 17. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- J. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- K. American Water Works Association (AWWA):
1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- L. FM Global:
1. FM P7825 - Approval Guide, (Factory Mutual).
 2. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- M. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - N. Intertek Testing Services (Warnock Hersey Listed):
 1. WH - Certification Listings.
 - O. Manufacturers Standardization Society of the Valve and Fittings Industry:
 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 67 - Butterfly Valves.
 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 8. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 9. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
 - P. National Electrical Manufacturers Association:
 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 2. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 3. NEMA MG 1 - Motors and Generators.
 - Q. National Fire Protection Association:
 1. NFPA 13 - Installation of Sprinkler Systems.
 2. NFPA 70 - National Electrical Code.
 3. NFPA 72 - National Fire Alarm Code.
 4. NFPA 99 - Standard for Health Care Facilities.
 - R. Underwriter Laboratories, Inc.:
 1. UL 263 - Fire Tests of Building Construction and Materials.
 2. UL 393 - Indicating Pressure Gages for Fire-Protection Service.
 3. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service.
 4. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 5. UL 1479 - Fire Tests of Through-Penetration Firestops.
 6. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 7. UL - Fire Protection Equipment Directory.
 8. UL - Fire Resistance Directory.
 9. Warnock Hersey - Certification Listings.
- 1.9 SUBMITTALS

- A. Section 21 05 02 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals
- B. The Contractor shall submit Certificates of Compliance for the following:
 - 1. Schedule of UL listed through penetration assemblies.

1.10 QUALITY ASSURANCE

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solutions to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.
- C. The Contractor shall guarantee all work, materials and equipment, furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- F. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- G. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- H. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.11 CLOSEOUT SUBMITTALS

- A. Division 01- Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of components and tag numbering.
 - 1. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the Professional.

2. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include the following:
 - a. Location and elevation of new and existing utility lines.
 - b. Points of connection to existing utility lines.
 - c. Changes in pipe routing location.
 - d. Valve locations.
 - e. Equipment locations, etc.
 - f. Actual capacities and values of equipment provided as indicated in equipment schedules
3. The marked-up record set of drawings shall be delivered to the Professional before final acceptance of the fire protection contract work.
4. Operation and Maintenance Data: Submit spare parts lists.

1.12 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Fire Protection Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. Maintain one copy of each document on site.

1.13 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- C. The Contractor shall be licensed by the North Carolina State Board of Examiners of Plumbing, Heating, and Fire Sprinkler Contractors. The contractor may be required to furnish evidence of satisfactory performance on previous sprinkler system installations of equivalent size, type, and complexity.

1.14 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.

- B. Convene minimum one week prior to commencing work of this section.
- C. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.
- D. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.
- E. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.
- F. Any differences identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. At his own expense, the Contractor shall protect his work, materials or equipment that is subjected to damage during the project duration. All openings into any piping, ducts or equipment shall be securely covered, or otherwise protected, to prevent injury due to carelessly or maliciously dropped tools or materials, grit, dirt, or any foreign material. The Contractor is responsible for all damage until his work is fully and finally accepted.
- D. The Contractor is responsible to provide protection for motors, pumps, electrical equipment, and all similar items of equipment from dirt, grime, plaster, water, etc. during all phases of construction. This protection shall be provided by covering equipment with transparent plastic sheeting and/or locating the materials and equipment in an area free from the elements.
- E. Furnish cast iron and steel valves with temporary protective coating.
- F. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.16 COORDINATION

- A. All existing service utilities shall remain active during the construction. Any service underground, aboveground, interior or exterior damaged, broken, or otherwise rendered inoperative during the course of construction due to activities on the part of the Contractor shall be properly repaired by the Contractor, at his own expense. The method used in repairing, replacing or maintaining the services shall be submitted to the Professional for review and approval.
 - 1. The Contractor shall schedule his work to avoid any major interruption of any utility services.
 - 2. Existing utilities serving occupied facilities shall not be interrupted except when such interruptions have been authorized in writing by the Owner or the Professional. Interruptions may occur only after acceptable, temporary utility services have been provided. The Contractor shall provide a minimum of ten (10) working days notice to the Professional and receive written notice to proceed before interrupting any utility.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of

construction, to allow for fire-suppression installations.

- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 - Access Doors and Frames.

1.17 PAINTING

- A. All exposed piping within finished areas shall be painted to match the adjacent surfaces. Refer to the architectural finish schedules for color selections.
- B. Properly prepare all surfaces before applying paint. Remove all foreign material and clean surface to be painted according to the paint manufacturer's recommendations.
- C. Apply proper primers and sealers as recommended by paint manufacturer.
- D. Refer to Division 09 – Painting for additional information regarding materials and requirements.
- E. All sprinkler heads installed in the piping system to be painted shall be covered with protective baggies by the fire sprinkler contractor as they are installed. Once the painting is complete the baggies shall be removed as directed by the contractor. Any painted or damaged sprinkler heads shall be replaced at no additional cost to the Owner.
- F. Refer to Division 21 Sections for additional information regarding the painting of piping.

1.18 RELATED WORK

- A. All work related to providing complete fire protection systems and equipment is the responsibility of the Contractor. The following related work shall be provided as indicated in other specification divisions, unless noted otherwise, but shall remain the responsibility of the Contractor for workmanship and completeness:
 - 1. General Contractor
 - a. Installation of access panels.
 - b. Final painting of existing walls, floors and ceilings where the surfaces are being refinished and remodeled under the General Contract. Refer to General Construction Drawings.
 - 2. Mechanical Contractor
 - a. Coordinate equipment, ducts and pipes for interference with fire protection system installation and performance.
 - 3. Electrical Contractor
 - a. Verification of the proper rotation of three-phase equipment, and making modifications as required correcting improper rotation.
 - b. Installation of all combination starters/disconnects and overload protectors.
 - c. Coordinate equipment, ducts and pipes for interference with fire protection system installation and performance.

1.19 MISCELLANEOUS STEEL AND ACCESSORIES

- A. The Contractor shall provide all necessary steel angles, channels, pipe, rods, nuts, bolts, etc., as shown on plans, as specified, or as may be required for complete and proper installation of

plumbing fixtures, systems and equipment. All material and workmanship shall be of the best quality and shall be installed in accordance with the best practices of the trade.

1.20 CLEANUP

- A. The Contractor shall maintain buildings, grounds and public properties free from accumulations of waste materials, debris and rubbish. At reasonable intervals during the progress of work, and when directed by the Owner's authorized representative, the site and public properties shall be cleaned. All waste materials, debris and rubbish shall be disposed of in appropriate manner. The Contractor shall provide containers for collection of waste materials, debris and rubbish. Waste materials, debris and rubbish shall be removed from the job site and legally disposed of at a landfill area in accordance with all applicable regulations. Burning or burying waste materials, debris or rubbish on project site is prohibited.
- B. At the completion of the project, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, surplus materials, etc., and clean all sight-exposed fire protection fixtures and equipment. Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed fire protection fixtures and equipment. Broom clean paved and concrete surfaces. Rake clean other ground surfaces. Repair, patch and touch up marred surfaces to the specified finish or to match adjacent surfaces.

1.21 INSPECTION AND TESTING

- A. New fire protection systems and parts of existing systems, which have been altered, extended or repaired, shall be tested to disclose leaks and defects.
- B. The Contractor shall develop a written test procedure for the Project. This procedure shall meet the requirements defined in NFPA 13. The test procedure shall be submitted to the Design Team for review a minimum of four (4) weeks before any testing begins.
- C. The sprinkler system testing shall include all of the system components including flow switches and tamper switches. The system shall be complete including the interfaces with the building fire alarm system prior to any system demonstrations.
- D. The Contractor shall notify the Professional a minimum of five (5) working days prior to testing to coordinate the testing and inspection procedures.
- E. If the Professional determines that the fire protection systems do not pass the prescribed tests, then the Contractor shall be required to make the necessary repairs, at his own expense, and the Contractor shall re-inspect and re-test the systems. Repairing, inspection and testing shall be continued until all systems pass as determined by the Professional.
- F. All new, altered, extended or replaced fire protection shall be left uncovered and unconcealed until it has been inspected, tested and accepted by the Professional. Where such work has been covered or concealed before it has been inspected, tested and accepted, it shall be uncovered by the Contractor, at his own expense as directed by the Professional.
- G. All equipment, material, labor, etc. required for testing the fire protection systems shall be furnished by the Contractor.

1.22 CUTTING, PATCHING, FINISHING

- A. Unless otherwise noted, the Contractor shall cut, patch and finish all chases and openings required for the installation of work to be performed under this Contract. All patching and finishing shall match existing adjacent undisturbed surfaces.
- B. Cutting shall not cause damage to the building or leave unsightly surfaces. The Contractor is responsible for the repair of these conditions.

- C. The Contractor shall contact the holder of the roofing guarantee and obtain his written approval before cutting the roofing membrane.
- D. No structural member shall be cut.
- E. Penetrations made in existing fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.
- F. All materials and methods to be used for patching and repairing shall be subject to the approval of the Professional and the Owner's Authorized Representative.
- G. The Contractor shall set all sleeves, hangers, and anchors required for the Fire Protection Contract work and shall be responsible for their proper and permanent location.
- H. No cutting shall be done which may affect the building structurally or architecturally without first securing the approval of the Professional. Cutting shall be accomplished in such a manner as not to cause damage to the building or leave unsightly surfaces, which cannot be concealed by plates, escutcheons or other construction. Where such unsightly conditions are caused, the Contractor shall be required, at his own expense, to repair the damaged areas.
- I. Cutting of the construction excessively or carelessly done shall be repaired to match the original work by the Contractor and to the satisfaction of the Professional who will make the final decision with respect to excessive or careless cutting work. The Contractor shall seal all openings he has made in plenum spaces, fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material.
- J. Where present equipment is removed and unused openings remain in walls, floors, partitions, etc., the Contractor shall properly patch all such openings except as specified under "Work by Others." All patching and repairing shall be done by workmen skilled in this type of work and shall match present or new finishes.
- K. Cutting, patching, and repairing of openings in the existing exterior walls and roof shall be by the General Contractor.

1.23 CHASES AND OPENINGS

- A. All chases and openings required for the installation of the work shall be coordinated with the other trades. The Contractor shall provide the other trades with sufficient time (one (1) week minimum) for coordination of all chases and openings. The Contractor shall be responsible for all work required cutting and patching the required openings. The work shall be performed to the satisfaction of the Professional.
- B. Penetrations made in fire rated chases, partitions, floors, etc. shall be sealed with an approved material and method as required to maintain the integrity of the fire separation.
- C. The Contractor shall provide all sleeves, hangers, and anchors required for installation of the work in chases and openings.

PART 2 - PRODUCTS

2.1 PIPE, TUBE AND FITTINGS

- A. All materials used on fire protection systems shall meet the requirements of applicable codes, standards, and requirements of local authorities having jurisdiction and the Owner's insurance carrier.
- B. Refer to individual Division 21 Sections for pipe, tube, and fitting materials and joining methods.

2.2 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 21 11 04 – HANGERS AND SUPPORTS.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13, NFPA 14, NFPA 20, and North Carolina Department of Insurance.
- B. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.
- C. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interference with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
- D. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion.
- E. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
- F. All materials and equipment used shall be installed in strict accordance with the Standards under which the materials are accepted and approved, and in strict accordance with the manufacturer's instructions.
- G. The contract documents are not intended to indicate every bend, offset, change in direction or appurtenance required to provide a complete and workable system.
- H. The contract drawings are diagrammatic and are indicative of the work to be performed. It is not intended that they show every pipe, fitting or apparatus required for a complete installation.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. All piping shall be installed with not less than 2-inches between finish covering of pipe and all other work or piping.
- E. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
- F. Bullhead connections in any piping service are prohibited.
- G. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings

removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.

3.3 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

3.4 VALVES

- A. Valves shall be installed at each riser, branch to floor, and where shown on the drawings. Valves shall be installed with stems at or above the horizontal plane.
- B. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- C. Install drain valves at main shut-off valves, low points of piping and apparatus.

3.5 PAINTING AND IDENTIFICATION

- A. Painting
 - 1. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces under this Contract shall be finished in an acceptable manner.
 - 2. All steel piping, equipment, supports, hangers and other iron and steel work in crawl spaces that is not factory painted, coated, or galvanized, installed under this Contract, shall be painted with two (2) coats of Rust-Oleum rust preventative paint, or approved equal. First coat shall be Rust-Oleum No. X-60 red primer, or accepted substitute. The second coat shall be Rust-Oleum No. 634 black gloss, or accepted substitute.
- B. Pipe Identification
 - 1. All piping shall be provided with identification markers. Markers shall be provided as follows:
 - a. On straight runs of piping at intervals not exceeding 20-feet.
 - b. Within 2-feet of all elbows.
 - c. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions).
- C. Valve Tags
 - 1. The Contractor shall tag each new valve furnished under this contract. The Contractor

shall prepare three (3) lists on heavy white paper giving the valve number, its location, and the equipment controlled. One (1) list shall be enclosed in a metal frame under glass and mounted in the building where directed by the Owner. The other two (2) copies shall be delivered to the Architect.

D. Ceiling Panel Identification

1. Provide colored plastic buttons and secure to lay-in ceiling tiles to identify access points for valves.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Inserts:

1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.7 PENETRATIONS AND ESCUTCHEONS

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
2. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
3. Insulated Piping: One-piece, stamped-steel type with spring clips.
4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
5. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
6. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
7. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
8. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
9. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
10. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.8 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Clean entire system after other construction is complete.

END OF SECTION 21 05 01

SECTION 21 05 02- FIRE PROTECTION SHOP DRAWINGS AND SUBMITTALS,
SUBSTITUTIONS AND O&M MANUALS

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. All catalog data, shop drawings, calculations and certificates of compliance shall be submitted as a single package. Failure of the Contractor to provide a complete submittal package may result in delay in processing time. All such delays to the project resulting from the Contractor's failure to provide submittals at one time will be the responsibility of the Contractor.
- C. Fire Sprinkler Contractor: The Contractor shall submit working shop drawings, hydraulic calculations, and product data to the design engineer of record – quantities as listed in the General Conditions or as otherwise indicated in the Division 21 Specifications. Shop drawings should include and be in accordance with working plan requirements of chapter 22 of NFPA 13. Product data should include and identify all material, equipment, and accessory selections to be installed. The hydraulic calculations and shop drawings should be signed by the fire sprinkler designer and include the NC Fire Sprinkler Contractor (FS) license number.
- D. Project Engineer: The specifying engineer (PE) has primary responsibility for review and approval of fire suppression system shop drawings and hydraulic calculations. Specifying Engineer review shall determine compliance with applicable codes and standards and the project contract documentation.

1.2 DEFINITIONS

- A. Shop Drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges and similar information.
- B. Samples: Units of typical work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed for the work to be provided, as designated.
- C. Manufacturer's Data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.
- D. Test Reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material/equipment provided or on identical material/equipment, and on installed electrical systems.
- E. Industry Standards: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications, unless otherwise indicated; within the text of these specifications the date-suffix frequently shown with identification numbers has been omitted.
- F. Manufacturer's Product Warranties: Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be

performed for the Purchaser or Owner by the Manufacturer, when and if the product fails within certain operational conditions and time limits.

- G. Operating Instructions: The written instructions by the manufacturers, fabricators, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down of each operating item of the equipment and each electrical system.
- H. Maintenance Manuals: The compiled information provided for the Owner that certain acts of restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.
- I. Final Inspection: At the final inspection, the fire sprinkler contractor should have for review and closeout documentation all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13). The shop drawing approval letter from this office should be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked 'Fire Sprinkler Shop Drawings' and securely fixed in the fire sprinkler riser room.

1.3 SUBMITTAL FORM AND PROCEDURES:

- A. General: Comply with Division 1 requirements for identification, quantities processing, scheduling and similar general requirements, except as otherwise indicated. Submittals shall be complete, in one package, clearly identified and cross-referenced to the appropriate specification section defining the submitted item. Partial submissions will not be addressed. The Contractor is responsible for any delays caused by incomplete submittal packages.
- B. Quantities: Provide quantities as listed in the General Conditions or as otherwise indicated in the Division 21 Specifications.
- C. Presentation: Submittals shall be assembled in three ringed binders with each specification section separated by a tab on which the specification section is noted. The submittals shall be clearly marked indicating which specific item is being considered and all its related information. Submittals not complying with these requirements are subject to being returned without being reviewed.
- D. Should Contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- E. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineer's current hourly billing rate. The Engineer's review time will be billed to the contractor whether the proposed substitution is accepted or rejected.
- F. Operating Instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation.
- G. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that the submitter has already determined that the products fulfill the specified requirements, and that the submittals are for the Architects' or Engineers' information only, but will be returned without action where observed to be non-complying with the requirements. Where uniquely prepared information is submitted, it is recognized to represent the preparer's interpretation or solution to the specified requirements, subject to the Architects', or Engineers' concurrence and appropriate action as indicated in Division 01.

- H. Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all shop drawings, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
 - I. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.
 - J. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents.
 - K. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.
 - L. The Engineer's review of shop drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the shop drawings.
 - M. The Contractor's shop drawing stamp shall indicate that the shop drawings have been checked for conformity to the Contract Documents and appropriate means have been taken to insure that the material and /or equipment will fit into the space available. Shop drawings will be returned without review if the submittals do not have the Contractor's stamp or the submittals have not been reviewed by the Contractor.
 - N. The Engineer's review of shop drawings is for general conformance with design concept only. The Contractor is responsible for all quantities, dimensions and coordination of the work of all trades. Corrections or comments made on the shop drawing during this review do not relieve the contractor from compliance with requirements of the contract documents. The Contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.
 - O. The Contractor shall stamp the shop drawings and submittals and verify by his/her signature that the shop drawings and submittals have been checked for compliance with the contract documents.
 - P. The Contractor shall provide TABLE A as a cover letter with the submittals. The "Date Submitted" column shall be filled in by the Contractor. The remaining three columns are for the Engineer's use.
- 1.4 GENERAL SUBMITTAL REQUIREMENTS:
- A. Applicability: Wherever it is indicated that a shop drawing, sample, manufacturer's brochure, certification, test, copy of standard operating instruction, manual, extra stock, guarantee or warranty is required, the appropriate submittal is required regardless of whether it is specified as a "submittal"; the Architects' or Engineers' decision shall be final.

1.5 SUBSTITUTIONS:

- A. Refer to the General Conditions for the requirements relative to substitutions.
- B. Substitutions: Fire Protection submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- C. Should Contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- D. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the contractor whether the proposed substitution is accepted or rejected.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Submit two (2) sets of 8-1/2" x 11" text as well as full-size drawings sixty (60) days prior to operator training/pre-final inspection bound in three D side ring capacity expansion binders with durable plastic covers for review by the Professional.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed or printed on thirty (30) pound white paper.
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Professional, Contractor, Subcontractors, and equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions arranged by system or process flow and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. Maintenance instructions for finishes, including recommended cleaning methods and materials and Operating instructions.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. All approved Submittals
 - b. Certificates of Compliance
 - c. Photocopies of warranties and bonds
 - d. Material safety data sheets
- E. Submit five (5) copies of completed volumes in final form fifteen (15) days prior to owner training. These copies will include Professional's previous review comments.
- F. Submit eight final volumes revised, within ten (10) days after pre-final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 21 05 02

TABLE A - Shop Drawings Required

Shop Drawings and Submittals Required for this Project	Date Submitted by Contractor	Date Received by Engineer	Date Returned by Engineer	Status
21 05 01 – Common Work for Fire Suppression				
21 05 53 – Identification				
21 11 01 – Fire Protection Piping and Fittings				
21 11 04 – Hangers and Supports				
21 23 13 – Wet Pipe Sprinkler Systems				

I have reviewed the shop drawings and submittals listed above for compliance with the contract documents.

Contractor's Signature

SECTION 21 05 53 - IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. Section includes:
 - 1. Nameplates.
 - 2. Valve Tags.
 - 3. Warning Tags.
 - 4. Stencils.
 - 5. Pipe markers.
 - 6. Ceiling markers.
- C. Related Sections:
 - 1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

- A. Refer to Section 21 05 01 for complete listing of references.

1.3 SUBMITTALS

- A. Section 21 05 02 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
 - 4. Brady Worldwide

2.2 EQUIPMENT NAMEPLATES

- A. Product Description:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Red.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2½ by ¾-inch.
 - 6. Minimum Letter Size: ¼-inch for name of units if viewing distance is less than 24-inches, ½-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.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.

2.3 VALVE TAGS

- A. Plastic Tags:
 - 1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1½-inches diameter.
 - 2. Fasteners: Brass beaded chain.
- B. Metal Tags:
 - 1. Brass, Aluminum or Stainless Steel with stamped letters; tag size minimum 1½-inches diameter or square with finished edges and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.

2.4 WARNING TAGS

A. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3¼ x 5-5/8-inches with grommet and self-locking nylon ties.

2.5 STENCILS

A. Stencils: With clean, die-cut symbols and letters of following size:

1. Up to 2-inches Outside Diameter of Insulation or Pipe: ½-inch high letters.
2. 2½ to 6-inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
3. Over 6-inches Outside Diameter of Insulation or Pipe: 1¾-inches high letters.
4. Equipment: 1¾-inches high letters.
5. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size, conforming to ASME A13.1.

2.6 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

1. Preprinted, color-coded, with lettering indicating service, and showing flow direction.
2. 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.
3. Lettering Size: At least 1½-inches high.

B. Plastic Pipe Markers:

1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:

1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.7 CEILING MARKERS

A. Description: Laminated three-layer plastic with 1/8-inch minimum engraved black letters on white background or color matching lay-in ceiling grid.

1. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
2. Match description used on Equipment Label or Valve Tag

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. All piping shall be labeled with direction of water flow.

- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install underground plastic pipe marker tape below finished grade, directly above buried pipe. Install detectable utility marking tape above all non-metallic, outside pipelines.
- G. Identify fire pumps and tanks with plastic nameplates. Identify in-line pumps and other small devices with tags.
- H. Identify valves with tags.
 - 1. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists; and, those supplied under other contracts, if applicable.
- I. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction, and pressure (where applicable). Install in clear view and align with axis of piping.
 - 1. On straight runs of piping at intervals not exceeding 20-feet
 - 2. Within 2-feet of all elbows
 - 3. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)
 - 4. Provide ceiling markers to locate valves and equipment above ceilings. Locate on ceiling or grid closest to valve or equipment location.

END OF SECTION 21 05 53

SECTION 21 11 01- FIRE PROTECTION PIPING

PART 1 - GENERAL

1.1 REQUIREMENTS

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. Fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- C. All piping material shall be manufactured in the USA.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:
 - 1. Automatic sprinkler system piping.

1.3 RELATED SECTIONS

- A. All sections of the Project Manual apply to this section.

1.4 REFERENCES

- A. Refer to Section 21 05 01 for complete listing of references.

1.5 SUBMITTALS

- A. Section 21 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. The Contractor shall submit manufacturer's catalog data for the following:
 - 1. Automatic sprinkler system piping.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION SYSTEM PIPING

- A. Aboveground
 - 1. Steel Pipe: ASTM A53, ASTM A795, Schedule 10 and 40 black.
 - a. Steel Fittings: ASME B16.9, wrought steel, butt-welded, ASME B16.25, butt-weld ends, ASTM A234, wrought carbon steel and alloy steel, ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 - b. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings, ASME B16.4, threaded fittings.
 - c. Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM A47.
 - d. Mechanical Grooved Couplings: Ductile iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized

for galvanized pipe.

- 1) Rigid Type: Housings shall be cast with bolt pad to provide system rigidity and support and hanging in accordance with NFPA 13.
 - a) 1-1/4" – 4": Rigid coupling designed for direct installation onto grooved end pipe without prior field disassembly.
 - b) 5" and Larger: Standard rigid coupling.
 - 2) Flexible Type: Use in seismic areas where required by NFPA 13.
 - e. Mechanical Grooved Fittings: ASTM A536 ductile iron and ASTM A53 steel fittings with grooved ends designed to accept couplings.
2. Flexible Piping.
- a. Flexible piping is not permitted.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13 and the manufacturer's recommendations.

3.2 PIPING INSTALLATION

A. General

1. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.
2. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interference with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
3. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion.
4. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
5. All piping shall be installed with not less than 2-inches between finish covering of pipe and all other work or piping.
6. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
7. All sprinkler head runouts shall be connected to top or side of mains/branches. Use of flexible heads are not permitted.

8. All piping shall be labeled with direction of water flow.
9. Bullhead connections in any piping service are prohibited.
10. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.
11. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by the coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.3 PROTECTION AGAINST PHYSICAL DAMAGE

- A. In concealed locations, where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1¼-inches from the nearest edge of the member, shield plates shall protect the pipe. Protective shield plates shall be a minimum of 1/16-inch thick steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 2-inches above sole plates and below top plates.

END OF SECTION 21 11 01

SECTION 21 11 04 - HANGERS AND SUPPORTS FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Formed steel channel.
 - 5. Firestopping relating to fire protection work.
 - 6. Firestopping accessories.
- B. Related Sections:
 - 1. Section 21 05 01 - Common Work Results for Fire
 - 2. Section 21 11 01 – Fire Protection Piping

1.3 REFERENCES

- A. Refer to Section 21 05 01 for complete listing of references.

1.4 DEFINITIONS

- A. Fire-stopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Fire-stopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM or UL requirements.
- B. Surface Burning: ASTM E84 UL 723 with maximum flame spread / smoke developed rating of 25/50.
- C. Fire-stop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire-stopping: Conform to applicable code (FM or UL) for fire resistance ratings and surface burning characteristics.
- B. Fire-stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Section 21 05 02 – Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.

- B. Shop Drawings:
 - 1. Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers, metal framing systems, pipe stands and/or equipment supports.
 - 2. Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.
 - C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Fire-stopping: Submit data on product characteristics, performance and limitation criteria.
 - D. Fire-stopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
 - E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
 - F. Welding certificates.
 - G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- 1.8 QUALITY ASSURANCE
- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.
 - B. Through Penetration Fire-stopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
 - C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
 - D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
 - E. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in

ASTM E84.

- F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with State, Federal and local standards approved by the Authority Having Jurisdiction.
- H. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with a minimum three years experience.

1.10 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply fire-stopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3-days after installation of fire-stopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.14 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Install in accordance with NFPA 13 for sprinkler systems.
- B. Install hangers to with minimum ½-inch space between finished covering and adjacent work.
- C. Where hanger rods are longer than 18-inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope wood or other makeshift device. Provide additional steel

supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.

- D. Roller type supports shall be used for pipes subject to axial movement. Brace so movement occurs in roller rather than support rod.
- E. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12-inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
- F. Place hangers within 12-inches of each horizontal elbow.
- G. Use hangers with 1½-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- H. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension through the wall. The use of toggle bolts will not be permitted.
- I. Prime coat exposed steel hangers and supports. Refer to Division 09 - Painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Division 09 - Painting.
- K. Do not penetrate building structural members unless indicated.
- L. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.
- M. Supports shall secure pipes in place, prevent swaying and vibration, maintain required grading, provide free expansion and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner, which will not stress building construction. A five (5) to one (1) safety factor relative to the gross weight of piping system including fluid shall be used in the selection of the supports. |
- N. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.
- O. Fastenings installed in masonry walls shall be galvanized u-bolts set in the construction during erection.
- P. Steel frame Construction
 - 1. Support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. Hanging from corrugated metal deck is prohibited.
 - 2. Where metal tabs integral with the metal deck are provided, support of piping, ductwork, devices and equipment from system to the maximum of the equivalent of a 10-foot length

of 4- inch diameter, Schedule 40 section of pipe filled with water or 6-inch diameter cast iron drainage pipe. Where tabs projecting down from the metal deck system are not available, inserts for concrete deck construction shall be installed. Inserts in poured concrete slabs shall be iron, fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one horizontal direction.

Q. Reinforced Concrete Construction

1. Where concrete members support concrete roof or floor construction, support piping systems, devices, and equipment from roof to floor construction by use of concrete slab inserts.
2. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.
3. Piping, tanks and equipment shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.
4. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1 inch.
5. Hangers shall be installed in accordance with the HANGER AND ROD SCHEDULE.

HANGER AND ROD SCHEDULE

Nominal Pipe	Steel Pipe	
<i>Diameter</i>	<i>Spacing</i>	<i>Rod Size</i>
(Inches)	(Feet)	(Inches)
½	5	3/8
¾	6	3/8
1	7	3/8
1¼	8	3/8
1½	10	3/8
2	10	3/8
2½ and 3	10	1/2
4 and 5	10	5/8
6	10	3/4
8, 10 and 12	10	7/8

HANGER AND ROD SCHEDULE NOTES:

Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.

Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12-inches from the joint.

Piping larger than 16-inches shall be supported according to the details on the drawings.

- R. Where more than one piping system material is specified, install compatible system components

and joints. Install flanges, union, and couplings at locations requiring servicing.

- S. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- T. All components of the hanger system shall UL listed and FM approved for use in fire protection systems.
- U. All hangers shall comply with the requirements of NFPA 13, The Standard for the Installation of Automatic Sprinkler Systems.
- V. Provide all steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.
- W. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.
- X. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.
- Y. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Paterson Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Globe Pipe Hanger Products Inc.
 - 5. Grinnell Corp.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- Z. Hanger Materials:
 - 1. Horizontal Fire Protection Piping:
 - a. 2-inch and smaller:

1)	B-Line	B3100
2)	Grinnell	260
3)	PHD	450
 - b. 2-1/2 inch and larger:

1)	B-Line	B3100
2)	Grinnell	260
3)	PHD	450
 - 2. Vertical Piping (Riser Clamps):
 - a. Steel Pipe:

1)	B-Line	B3373
2)	Grinnell	261
3)	PHD	550

3. Connectors:
 - a. Beam Clamps:
 - 1) B-Line B3033, B3050, B3291-B3297
 - 2) Grinnell 88, 133, 134 or 292S.
 - 3) PHD 360, 620
 - b. Concrete inserts:
 - 1) B-Line B2500, B3014
 - 2) Grinnell 282, 285
 - 3) PHD 950
 - c. Welded beam attachments:
 - 1) B-Line B3083
 - 2) Grinnell 66
 - 3) PHD 900
 - d. Piping adjacent to walls or steel columns, brackets:
 - 1) B-Line
 - 2) Grinnell
 - 3) PHD
 - e. Base supports:
 - 1) B-Line
 - 2) Grinnell
 - 3) PHD
4. Hanger Rods:
 - a. Hanger rod:
 - 1) B-Line
 - 2) Grinnell
 - 3) PHD
 - b. Continuous threaded rod:
 - 1) B-Line
 - 2) Grinnell
 - 3) PHD
 - c. Eye Rods:
 - 1) B-Line
 - 2) Grinnell
 - 3) PHD

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Under-deck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with NFPA 13, North Carolina Department of Insurance and the manufacturers' recommendations.

3.2 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive fire-stopping.

3.3 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission from the Professional before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.4 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4-inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.5 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. The Contractor shall furnish and install all supports, hangers, inserts and fasteners for the items incidental to the work in the construction of the project. Supports and hangers shall be provided to suit specific conditions for the type of construction. The method adopted shall be subject to the approval of the Professional.
- B. Supports shall secure pipes in place; prevent swaying and vibration; maintain required grading; provide free expansion and shall have a neat appearance. Supports shall be selected for strength and service and installed in a manner, which will not stress building construction. A five (5) to one (1) safety factor relative to the gross weight of piping system including fluid shall be used in the selection of the supports.
- C. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Only use inserts for suspending hangers from concrete slabs. Use beam clamps for suspending hangers from building steel. Do not hang one pipe from another. Do not use perforated band iron, wire or chain as hangers. Do not use vertical expansion shields. Do not hang from joist bridging.
- D. Fastenings installed in masonry walls shall be galvanized u-bolts set in the construction during erection.
- E. All vertical piping shall be supported at each floor level. Riser clamps at exposed locations shall be of such design as to avoid creating a hazardous or unsightly condition and stay within space limitations. Pipe supports are required at the base of all vertical risers and shall be of riser size.
- F. Where hanger rods are longer than 18-inches, provide lateral bracing at every fourth hanger. Do not support piping by wire, rope wood or other makeshift device. Provide additional steel supports where building construction does not permit the hanger spacing as specified in the schedules. Location and details shall be submitted to the Professional for review.
- G. Where loading exceeds the safe allowable limit for any single insert, then multiple inserts shall be installed spaced no less than 12-inches on centers. The multiple inserts shall be connected with suitable size steel angles and locking bolts.
- H. Where fastenings are required in steel stud, wire lath or other non-masonry construction, a "J" hook and holding lock washer and nut shall be used which shall fasten to the opposite stud edge to which the item will abut. If the location of the fastening is not a steel stud, a structural steel shape shall be fastened to the wall with bolt and holding nut, with the fastening extension

through the wall. The use of toggle bolts will not be permitted.

I. Steel frame Construction

1. Support piping systems, devices, and equipment from structural steel members or secondary fabricated supports. Hanging from corrugated metal deck is prohibited.
2. Where metal tabs integral with the metal deck are provided, support of piping, ductwork, devices and equipment from system to the maximum of the equivalent of a 10-foot length of 4- inch diameter, Schedule 40 section of pipe filled with water or 6-inch diameter cast iron drainage pipe. Where tabs projecting down from the metal deck system are not available, inserts for concrete deck construction shall be installed. Inserts in poured concrete slabs shall be iron, fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one horizontal direction.

J. Reinforced Concrete Construction

1. Where concrete members support concrete roof or floor construction, support piping systems, devices, and equipment from roof to floor construction by use of concrete slab inserts.
2. Inserts in poured concrete slabs shall be iron or fabricated galvanized iron or steel of the type to receive a machine bolt head or nut after installation and shall permit adjustment of this bolt in one (1) horizontal direction. Inserts shall be accurately located before the concrete is poured.
3. Piping shall be adequately supported either by suspension from the construction above or by means of struts or brackets to the construction below or to the side.
4. Before drilling any concrete for attachments, installer shall carefully check concrete drawings and shop drawings and shall locate drilled holes to avoid reinforcing by at least 1-inch.
5. Hangers shall be installed in accordance with the HANGER AND ROD SCHEDULE. (see SCHEDULES below)
- 6.

3.6 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1½-inches above finished floor level. Caulk sleeves. Extend sleeves through floors 3-inches above finished floor level in Kitchen or wet-areas.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with fire-stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or stainless steel escutcheons at finished surfaces.

3.7 INSTALLATION – FIRE-STOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring fire-stopping.

- B. Apply primer where recommended by manufacturer for type of fire-stopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire-stopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- F. Place intumescent coating in sufficient coats to achieve rating required.
- G. Remove dam material after fire-stopping material has cured.
- H. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- I. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof openings as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Install type of fire-stopping material recommended by manufacturer.
 - 2. Install escutcheons, floor plates, or ceiling plates where exposed piping penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at computer rooms, electrical panel rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.8 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements or Division 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed fire-stopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of fire-stopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.11 HANGER AND ROD SCHEDULE NOTES:

- A. Where unusual concentrated loads of valves and fittings occur, closer spacing shall be required. Submit specific cases for review and comment.
- B. Where piping changes direction, supports shall be placed in each direction adjacent to joints and no more than 12-inches from the joint.
- C. Piping larger than 16-inches shall be supported according to the details on the drawings.

END OF SECTION 21 11 04

SECTION 21 23 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.

1.2 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 21 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 21 specifications contain statements more definitive or more restrictive.
- C. Section includes wet-pipe sprinkler system, system design, installation, and certification.

1.3 REFERENCES

- A. Refer to Section 21 05 01 for complete listing of references.

1.4 SYSTEM DESCRIPTION

- A. System to provide coverage for the entire building as noted.
- B. Provide hydraulically designed system to NFPA 13 occupancy requirements as noted on the drawings.
- C. The Contractor shall obtain flow test data for the design of the hydraulic calculations. Design shall be based on flow test data and submitted to the Professional with the hydraulic calculations.
- D. Interface system with the building fire and smoke alarm system.
- E. Provide fire department connections as indicated on Drawings.

1.5 SUBMITTALS

- A. All submittals shall be reviewed and accepted by the General Contractor and prior to submittal to the Professional.
The Specifying Engineer (PE) has primary responsibility for review and approval of fire suppression system shop drawings and hydraulic calculations. Specifying Engineer shall review and determine compliance with applicable codes and standards and the project contract documentation. After completing this review, the Engineer sends one (1) copy with a signed cover letter, including printed reviewer name, summarizing the outcome to the State Construction Office for approval.
- B. Section 21 05 02 - Fire Protection Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- C. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- D. Product Data: Submit data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support

requirements, and piping connections.

- E. Design Data: Submit design calculations; signed and sealed by a Professional Engineer.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13, State, Federal, local code and the Authority Having Jurisdiction.
- B. Maintain one (1) copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of North Carolina.

1.9 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Store products in shipping containers until installation.
- C. Furnish piping with temporary inlet and outlet caps until installation.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish extra sprinklers under provisions of NFPA 13.
- C. Furnish suitable wrenches for each sprinkler type.
- D. Furnish metal sprinkler head storage cabinet(s) in location designated by the Owner.

PART 2 - PRODUCTS

2.1 Listing / Approval

- A. All sprinkler system materials and components must be UL Listed and FM Approved, and used in strict conformance to the conditions of their Listing or Approval.
- B. All sprinklers shall be quick response type.
- C. Recessed pendant sprinkler head escutcheons shall be listed.
- D. Suspended Ceiling: Concealed pendant type with matching push-on escutcheon trim, chrome finish with glass bulb type or fusible link. Temperature rating of sprinkler head shall be suitable for specific area hazard.
- E. Exposed Areas: Standard upright type, brass finish with glass bulb type or fusible link. Temperature rating of sprinkler head shall be suitable for specific area hazard.

2.2 SPRINKLERS

- A. Manufacturers:
 - 1. Viking Corp.
 - 2. AFAC Inc
 - 3. Grinnell Fire Protection.
 - 4. Reliable Automatic Sprinkler Co., Inc.
 - 5. Victaulic Co. of America.
- B. Suspended Ceiling Type:
 - 1. Type: Concealed pendant type with matching push on escutcheon plate.
 - 2. Finish: Coordinate sprinkler and escutcheon finish and color with the Project Architect.
 - 3. Fusible Link: Fusible solder link type or Glass bulb type; temperature rated for specific area hazard.

2.3 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3½- to 4½-inches diameter dial with dial range of 0 - 250 psig.

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics: In accordance with Division 26 and Section 21 05 03.
- B. Controls: Supervisory switches, Flow Switches, Pressure Switches,

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. All sprinkler head runouts shall be connected to top or side of mains/branches. Use of flexible heads are not permitted.
- C. All piping shall be labeled with direction of water flow.
- D. Place pipe runs to minimize obstruction to other work.
- E. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffiting as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation. Install piping as high as possible.

- F. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interferences with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
- G. All piping shall run straight with no more couplings and joints than necessary and shall be carefully installed to provide for proper alignment and slope.
- H. All piping shall be installed with not less than 2-inches between piping and all other work or piping.
- I. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
- J. Piping shall be properly arranged and graded to low points where the entire system can be emptied through a drain.
- K. Drain valves shall be provided to drain all sections of the piping system.
- L. Automatic sprinklers in the finished ceilings shall be located in accordance with the criteria defined in NFPA 13. These heads locations shall be reviewed and approved by the Project Architect before the contractor begins his hydraulic calculations.
- M. Install guards on sprinklers where required by NFPA 13.
- N. Hydrostatically test entire system.
- O. Require test be witnessed by the Owner, and Architect/Engineer.

3.2 INSTALLATION, TEST, AND CERTIFICATION

- A. All sprinkler valves and controls shall be located for safe and convenient access during emergencies and testing. Control valves shall not be located above ceilings. Inspector's Test Connections should be operable from floor level.
- B. Identify each valve and control with a prominent engraved phenolic or stamped metal placard. Any such devices which are behind access doors or panels must also have an appropriate placard on the means of access.
- C. Provide an auxiliary drain for each location where the piping pitch prevents complete drainage through the main drain valve. If the capacity of the trapped section exceeds five (5) gallons, a valve must be provided and the outlet piped to a drain or convenient location acceptable to the Authority Having Jurisdiction.

3.3 CONTRACTOR'S INSPECTION OF SYSTEM

- A. NCSSM shall be notified 48 hours in advance of all testing and inspections.
- B. The Contractor shall thoroughly inspect the completed system to assure compliance with this document, project plans and specs, and all applicable Codes and Standards. This must include an operational test of each water flow alarm switch and all system supervisory devices (valve tamper, hi-low air pressure, fire pump status, etc, where provided). This testing shall be performed in coordination with the fire alarm system contractor.
- C. At the final inspection, the fire sprinkler contractor should have for review and closeout documentation all pertinent NFPA paperwork properly filled out on NFPA forms as applicable (NFPA 13, 14, 20, 24). The shop drawing approval letter from this office should be available. A set of as-built fire sprinkler shop drawings and hydraulic calculations shall be placed in a white PVC tube marked "Fire Sprinkler Shop Drawings" and securely fixed in the fire sprinkler

riser room.

3.4 CONTRACTOR'S MATERIAL AND TEST CERTIFICATES

- A. Prior to requesting the Professional to set up the final inspection, complete and submit copies of the MATERIAL AND TEST CERTIFICATES to the following:
 - 1. Professional
 - 2. Owner

3.5 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Flush entire piping system of foreign matter.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 01 - Execution and Closeout Requirements: Protecting installed construction.
- B. Provide protective covers, skids, plugs or caps to protect materials from damage or deterioration during construction.
- C. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting.
- D. Replace inadvertently painted sprinklers with new.

END OF SECTION 21 23 13

DIVISION 22 – PLUMBING SPECIFICATIONS TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>
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22 05 02	PLUMBING SHOP DRAWINGS AND SUBMITTALS, SUBSTITUTIONS AND O&M MANUALS
22 05 53	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 11 01	PLUMBING PIPING
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22 11 03	PLUMBING INSULATION
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22 11 23	FACILITY NATURAL GAS PIPING



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SECTION 220501 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the contract documents including General and Supplementary Conditions and Division 00 and 01 Specification sections apply to all work in this section.
- B. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.
- C. Nothing herein contained shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of these drawings and specifications. He will be held to provide and install all materials and equipment and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. He is also responsible for the proper coordination of his work with all other trades.
- D. The Contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.2 SCOPE

- A. Perform work and provide material and equipment as shown on Drawings and/or as specified and/or indicated in this Section of the Specifications. Completely coordinate work of Divisions 22 with work of other trades and provide a complete and fully functional installation.
- B. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.
- C. It is the intent that these Specifications and Drawings are to establish minimum requirements for methods, products and equipment and to provide electrical service, distribution and systems finished, tested and ready for operation. Incidental detail not usually shown or specified, but necessary for proper installation and operation shall be included in the work and this Contractor's estimate, the same as if specified. Locations of all equipment and material shall be adjusted at no extra cost to the Owner, to accommodate the work interferences anticipated and/or encountered. Prior to installation, determine the exact route and location of each raceway and piece of equipment to minimize conflicts with other trades.
- D. Give notices, file plans, obtain permits and licenses, pay fees and back-charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
- E. Division 22 Contractor shall furnish all motor starters and disconnect switches as required by NEC for equipment motors, unless specifically noted otherwise in the specifications or on the drawings. Motor starters and disconnect switches shall be in accordance with Division 26 Specifications.
- F. If a Guaranteed Maximum Price (GMP) has been prepared using documents prior to the issuance of the 100% Bid Documents, the Contractor shall identify any and all changes to the

GMP, either increasing or decreasing the GMP amount. All changes shall be numbered and circled, in both drawings and specifications. The Contractor shall also provide detailed cost back-up for all items noted above.

- G. Work consists of furnishing all labor, material, equipment and services necessary and reasonably incidental to the proper completion and proper operation of the plumbing systems. The work shall consist of but shall not necessarily be limited to the following:
 - 1. Domestic water system including extension of piping and connections to all equipment, and accessories.
 - 2. Modifications to existing plumbing systems, equipment, fixtures, and accessories as indicated and as specified.
 - 3. Removal of plumbing systems, equipment, piping, etc., no longer required as a part of the revised installations.
 - 4. Piping and equipment insulation for existing systems and equipment to remain and repair damaged coverings or as required completing continuous coverage.
 - 5. Domestic Water Systems as defined in the Contract Documents.
 - 6. Natural Gas Piping and accessories as defined in the Contract Documents.
- H. The General Conditions shall be carefully examined before proposals for any work are submitted. Division 22 shall not be interpreted as waiving or overruling any requirements expressed in the General Conditions unless Division 22 specifications contain statements more definitive or more restrictive.
- I. Nothing herein shall be so construed to relieve the Contractor from doing his work according to the true intent and meaning of the drawings and specifications. He will be held to provide and install all materials and equipment, and shall furnish all labor necessary for the complete, prompt and satisfactory execution of the work. Also he is responsible for properly coordinating his work with all other trades.
- J. The contractor shall bear all expenses incidental to the satisfactory completion of the work contained in these specifications and drawings.

1.3 DEFINITIONS AS USED IN THESE SPECIFICATIONS

- A. "Provide," means "furnish and install."
- B. "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support."
- C. "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."
- D. "Architect" means the "Prime Design Consultant," and if United Engineering Group, Inc. is not the prime design consultant, the Architect may authorize United Engineering Group to act on the Architect's behalf in matters concerning the Division 22 series of specifications.
- E. "RFI" means Contractor's "Request for Information."
- F. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- G. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied

spaces and mechanical equipment rooms.

- H. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- I. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PP: Polypropylene plastic.
 - 5. PVC: Polyvinyl chloride plastic.
- J. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 CONTRACT DOCUMENTS

- A. Listing of Drawings does not limit responsibility of determining full extent of work required by these Contract Documents. Refer to Architectural, HVAC, Plumbing, Fire Protection, Electrical, Structural, Site Utility and all other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of Divisions 22 must be coordinated.
- B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.
- C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.
- D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.
- E. Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.
- F. Data that may be furnished electronically by the Architect (on computer tape, diskette, or otherwise) is diagrammatic. Such electronically furnished information is subject to the same limitation of precision as heretofore described. If furnished, such data is for convenience and generalized reference, and shall not substitute for Architect's sealed or stamped construction documents.

1.5 DISCREPANCIES IN DOCUMENTS

- A. Where Drawings or Specifications conflict or are ambiguous, the contractor shall advise the Architect in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or ambiguities thus resolved.

- B. Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.
- C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specifications, this contractor shall provide that material, installation, or work which is of the higher, more stringent standard.
- D. The Contract Documents require the Contractor to provide systems and components that are fully complete, operational and suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements. In cases such as this, where the Contractor has failed to notify the Architect of the situation in accordance with Paragraph (A) above, the Contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.
- E. In cases covered by Paragraph (D) above, where the Contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Architect shall review and advise the contractor of the disposition.

1.6 MODIFICATIONS IN LAYOUT

- A. Plumbing Drawings are diagrammatic. They indicate general arrangements of plumbing systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.
- B. In order to obtain the Architect's desired aesthetics in spaces used by building occupants, in all such spaces, prior to installation of visible material and equipment (including access panels) review Architectural Drawings for desired locations and where not definitely indicated, request information from Architect.
- C. Check Contract Documents, as well as, Submittals and Shop Drawings of all subcontractors to verify and coordinate spaces in which work of Division 22 will be installed.
- D. Maintain maximum headroom at all locations. All piping, duct, conduit and associated components to be as tight to underside of structure as possible.
- E. Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C and D above. Systems shall be run in a rectilinear fashion.
- F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect for review and approval.

1.7 REQUESTS FOR INFORMATION (RFI'S)

- A. If the RFI is a request to resolve a conflict or an ambiguity, or a request for additional detail, Contractor's RFI shall include a sketch or equivalent description of Contractor's proposed solution, in accordance with paragraphs 1.5 (E) and 1.6 (F) above.
- B. To expedite the flow of RFI's, for all RFI's under Divisions 22, Contractor shall submit the attached form, or similar form including the same information, to the Architect, with copy to United Engineering Group. Contractor shall include proposed solution in the indicated space on the form.

1.8 REFERENCES

- A. The Contractor shall comply with all laws, ordinances, and regulations of all authorities having jurisdiction, including those of all applicable city, county, state, federal and public utility entities. The Contractor shall obtain all licenses, permits, etc. and shall pay all associated connection fees, tapping fees, inspection fees, etc. This cost shall be included in the contract price.
- B. The publications listed below form a part of this specification. All publications shall be the latest edition with Amendments as adopted by the authority having jurisdiction. The minimum standard of work under this contract shall be in accordance with the following model building codes:
 - 1. North Carolina State Building Code:
 - a. Building, 2018 edition
 - b. Plumbing, 2018 edition
 - c. Mechanical, 2018 edition
 - d. National Electric Code, latest edition
 - e. Fire Protection, 2018 edition
 - f. Energy Conservation Code, 2018 edition
- C. The minimum design and construction parameters of the work shall be in accordance with the following standards:
 - 1. AABC - National Standards for Total System Balance.
 - 2. Air-Conditioning and Refrigeration Institute:
 - a. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
 - b. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
 - 3. American Bearing Manufacturers Association:
 - a. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American National Standards Institute:
 - a. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - b. ANSI S1.4 - Sound Level Meters.
 - c. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - d. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
 - e. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.
 - f. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
 - 5. American Society of Mechanical Engineers:
 - a. ASME A13.1 - Scheme for the Identification of Piping Systems.
 - b. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - c. ASME A112.18.1 - Plumbing Fixture Fittings.
 - d. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.

- e. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
 - f. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - g. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
 - h. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.
 - i. ASME A112.21.1 - Floor Drains.
 - j. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - k. ASME B16.3 - Malleable Iron Threaded Fittings.
 - l. ASME B16.4 - Gray Iron Threaded Fittings.
 - m. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - n. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - o. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
 - p. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 - q. ASME B31.9 - Building Services Piping.
 - r. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
 - s. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - t. ASME PTC 25 - Pressure Relief Devices.
6. American Society of Sanitary Engineering:
- a. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
 - b. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
 - c. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
 - d. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
 - e. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
 - f. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
7. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
- a. ASHRAE Handbook - HVAC Applications.
 - b. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - c. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
8. ASTM International:

- a. ASTM A47 - Standard Specification for Ferritic Malleable Iron Castings.
- b. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- c. ASTM A74-09 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- d. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- e. ASTM A234 - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- f. ASTM A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- g. ASTM A536 - Standard Specification for Ductile Iron Castings.
- h. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
- i. ASTM A795/A795M-08 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
- j. ASTM B32 - Standard Specification for Solder Metal.
- k. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
- l. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- m. ASTM B75 - Standard Specification for Seamless Copper Tube.
- n. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- o. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- p. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- q. ASTM B302 - Standard Specification for Threadless Copper Pipe.
- r. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
- s. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- t. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- u. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- v. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- w. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- x. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- y. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- z. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

- aa. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
 - bb. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - cc. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - dd. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - ee. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
 - ff. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor
 - gg. ASTM E1 - Standard Specification for ASTM Thermometers.
 - hh. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
 - ii. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - jj. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - kk. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 - ll. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 - mm. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
 - nn. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - oo. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
9. American Welding Society:
- a. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 - b. AWS D1.1 - Structural Welding Code - Steel.
10. American Water Works Association:
- a. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - c. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3-inches. through 48-inches, for Water and Other Liquids.
 - d. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - e. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - f. AWWA C651 - Disinfecting Water Mains.

11. Cast Iron Soil Pipe Institute:
 - a. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
12. FM Global:
 - a. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
13. International Electrical Testing Association:
 - a. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
14. Intertek Testing Services (Warnock Hersey Listed):
 - a. WH - Certification Listings.
15. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - a. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - b. MSS SP 67 - Butterfly Valves.
 - c. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - d. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - e. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
16. National Electrical Manufacturers Association:
 - a. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
17. National Fire Protection Association:
 - a. NFPA 99 - Standard for Health Care Facilities.
18. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
19. Plumbing and Drainage Institute:
 - a. PDI WH201 - Water Hammer Arrester Standard.
20. Underwriter Laboratories, Inc.:
 - a. UL 263 - Fire Tests of Building Construction and Materials.
 - b. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - c. UL 842 - Valves for Flammable Fluids.
 - d. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - e. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - f. UL - Fire Resistance Directory.
21. United States Department of Energy:

- a. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.9 SUBMITTALS

- A. Section 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. The Contractor shall submit Certificates of Compliance for the following:
 - 1. Schedule of UL listed through penetration assemblies

1.10 ELECTRICAL EQUIPMENT

- A. Refer to Section 22 05 03 of this manual for the requirements relating to electrical equipment.

1.11 CONTROL WIRING

- A. Refer to Section 22 05 03 of this manual for the requirements relating to wiring.

1.12 QUALITY ASSURANCE

- A. The Contractor shall guarantee all work, materials and equipment, furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- B. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- C. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- D. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.13 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and tag numbering.
 - 1. Changes from the contract drawings necessary to coordinate the work with other trades, to conform to the building conditions or to conform to the rules and regulations of authorities having jurisdiction shall be made only after obtaining written permission from the Professional.
 - 2. The Contractor shall keep a record of construction changes and deviations from the original contract drawings. All changes shall be recorded on a separate set of prints, which shall be kept at the job site specifically for that purpose. The record shall be made immediately after the work is completed. Documentation shall include the following:
 - a. Location and elevation of new and existing utility lines.
 - b. Points of connection to existing utility lines.

- c. Changes in pipe routing location.
 - d. Valve locations.
 - e. Equipment locations, etc.
 - f. Actual capacities and values of equipment provided as indicated in equipment schedules
3. The marked-up record set of drawings shall be delivered to the Professional before final acceptance of the fire protection contract work.
4. Operation and Maintenance Data: Submit spare parts lists.

1.14 QUALITY ASSURANCE

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

1.15 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

1.16 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- C. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. When it has been indicated that these utilities are to remain in place, the Contractor shall provide adequate means of support and protection during excavation operations.
- D. Before ordering any equipment and material, or performing any work, the Contractor shall verify all measurements and dimensions at the job site. The Contractor is responsible for the correctness of this information.
- E. No extra compensation will be considered based on differences between actual dimensions and measurements and those indicated on the drawings.
- F. Any differences identified by the Contractor shall be submitted to the Professional for consideration before proceeding with the work.

1.17 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping,

storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

- D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.18 COORDINATION

- A. The Contractor shall coordinate his work with that of the other trades. Where interference with other trades occurs, the Contractor shall present his solution to the Professional. The Professional shall make the final decision regarding changes to be made in the work.
- B. The Contractor shall thoroughly familiarize himself with all specifications and drawings for the project so that he clearly understands his responsibility in relationship to the work to be performed. The Contractor shall plan and perform his work so as to permit the use of the building at the earliest possible date.
- C. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- D. The Contractor shall expressly and completely follow all manufacturers' instructions required for validation of the manufacturer's warranty agreement including but not limited to service, maintenance and adjustments of the equipment.
- E. The Contractor is responsible for the proper installation of all materials and equipment required for a complete installation within the intent and meaning of the contract documents.
- F. Prepare coordination drawings at a scale of $\frac{1}{4}" = 1'-0"$ or larger, detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. The Plumbing Contractor will use the coordination drawings prepared by the Mechanical Contractor to show equipment and materials for coordination between trades. The coordination drawings will be prepared before installation of any plumbing, sprinkler, mechanical or electrical work and will be shown as a task on the Project Schedule to be prepared by the General Contractor.
- G. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 - Access Doors and Frames.
- H. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- I. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

1.19 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Refer to individual Division 22 Sections for specific materials and/or products.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 Sections for special joining materials not listed below.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements 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 on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07 Section "Penetration Fire-stopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 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. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
 - H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 3.3 PIPING CONNECTIONS
- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2½ and larger, adjacent to flanged valves and at final connection to each piece of equipment.
- 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
 - B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
 - C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
 - D. Install equipment to allow right of way for piping installed at required slope.
- 3.5 PAINTING
- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting."
 - B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

END OF SECTION

SECTION 22 05 02 - PLUMBING SHOP DRAWINGS AND SUBMITTALS, SUBSTITUTIONS AND O&M MANUALS

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. All catalog data, shop drawings, calculations and certificates of compliance shall be submitted as a single package. Failure of the Contractor to provide a complete submittal package may result in delay in processing time. All such delays to the project resulting from the contractor's failure to provide submittals at one time will be the responsibility of the contractor.

1.2 DEFINITIONS

- A. Shop Drawings: Project shop drawings and other data prepared specifically for fulfillment of the project requirements. Shop drawings include fabrication, layout, setting, installation, coordination and similar drawings and diagrams, and include performance data associated therewith, including weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, cycles, phases, noise levels, operating ranges and similar information.
- B. Samples: Units of typical work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed for the work to be provided, as designated.
- C. Manufacturer's Data: Product manufacturer's standard printed product information, including promotional brochures, product specifications, installation instructions and diagrams, statements of compliance with standard performance charts or curves, and similar information concerning the standard portions of the manufacturer's products.
- D. Test Reports: Specific reports prepared by independent testing laboratories and others, showing the results of specified testing on either the material/equipment provided or on identical material/equipment, and on installed electrical systems.
- E. Industry Standards: Printed copies of the current standards recognized in the industry. Current means the latest issue as of the date of these specifications, unless otherwise indicated; within the text of these specifications the date-suffix frequently shown with identification numbers has been omitted.
- F. Manufacturer's Product Warranties: Manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed for the Purchaser or Owner by the Manufacturer, when and if the product fails within certain operational conditions and time limits.
- G. Operating Instructions: The written instructions by the manufacturers, fabricators, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down of each operating item of the equipment and each electrical system.
- H. Maintenance Manuals: The compiled information provided for the Owner that certain acts of restitution will be performed when and if certain portions of electrical work fail within certain operational conditions and time limits.

1.3 SUBMITTAL FORMS AND PROCEDURES

- A. General: Comply with Division 1 requirements for identification, quantities processing, scheduling and similar general requirements, except as otherwise indicated. Submittals shall be complete, in one package, clearly identified and cross-referenced to the appropriate

specification section defining the submitted item. Partial submissions will not be addressed. The Contractor is responsible for any delays caused by incomplete submittal packages.

- B. Submittal Tracking: The Contractor shall refer to 22 05 02 - Table A for a listing of the required submittals. The Schedule shall be included as part of his submission with those portions of the schedule for which he is responsible filled out. The Schedule will be used to track the submittal through the review process.
- C. Quantities: Provide quantities as listed in the General Conditions or as otherwise indicated in the Division 22 Specifications.
- D. Presentation: Submittals shall be assembled in three ringed binders with each specification section separated by a tab on which the specification section is noted. The submittals shall be clearly marked indicating which specific item is being considered and all its related information. Submittals not complying with these requirements are subject to being returned without being reviewed.
- E. Substitutions: Plumbing submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- F. Should the Contractor desire to substitute another manufacturer's equipment for one specified by name, the contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- G. Any time that is required by the Engineer for a request to review submittals for substitute equipment after the award of bids will be billed to the contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the contractor whether the proposed substitution is accepted or rejected.
- H. Operating Instructions: The written instructions by the manufacturer, fabricator, or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation.
- I. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that the submitter has already determined that the products fulfill the specified requirements, and that the submittals are for the Architects' or Engineers' information only, but will be returned without action where observed to be non-complying with the requirements. Where uniquely prepared information is submitted, it is recognized to represent the preparer's interpretation or solution to the specified requirements, subject to the Architects', or Engineers' concurrence and appropriate action as indicated in Division 1.
- J. Shop Drawings and Samples: After checking and verifying all field measurements, the Contractor shall submit to the Engineer for review, in accordance with the accepted schedule of shop drawings submissions, copies of all shop drawings, which shall have been checked by and stamped with the approval of the Contractor and identified as the Engineer may require. The data shown on the shop drawings shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable the Engineer to review the information as required.
- K. The Contractor shall also submit to the Engineer for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and stamped with the approval of the Contractor, identified clearly as to material, manufacturer, any pertinent catalog numbers and the use for which intended.

- L. At the time of each submission, the Contractor shall in writing call the Engineer's attention to any deviations that the shop drawings or sample may have from the requirements of the Contract Documents.
- M. No work requiring a shop drawing or sample submission shall be commenced until the submission has been reviewed by the Engineer. A copy of each shop drawing and each approved sample shall be kept in good order by the Contractor at the site and shall be available to the Engineer.
- N. The Engineer's review of shop drawings or samples shall not relieve the Contractor from his responsibility for any deviations from the requirements of the Contract Documents unless the Contractor has in writing called the Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation, nor shall any review by the Engineer relieve the Contractor from responsibility for errors or omissions in the shop drawings.
- O. The Contractor's shop drawing stamp shall indicate that the shop drawings have been checked for conformity to the Contract Documents and appropriate means have been taken to insure that the material and /or equipment will fit into the space available. Shop drawings will be returned without review if the submittals do not have the Contractor's stamp or the submittals have not been reviewed by the Contractor.
- P. The Engineer's review of shop drawings is for general conformance with design concept only. The Contractor is responsible for all quantities, dimensions and coordination of the work of all trades. Corrections or comments made on the shop drawing during this review do not relieve the contractor from compliance with requirements of the contract documents. The Contractor is responsible for selecting fabrication processes and techniques of construction and for performing all work in a safe and satisfactory manner.
- Q. The Contractor shall stamp the shop drawings and submittals and verify by his/her signature that the shop drawings and submittals have been checked for compliance with the contract documents.
- R. The Contractor shall provide TABLE A as a cover letter with the submittals. The "Date Submitted" column shall be filled in by the Contractor. The remaining three columns are for the Engineer's use.

1.4 GENERAL SUBMITTAL REQUIREMENTS

- A. Applicability: Wherever it is indicated that a shop drawing, sample, manufacturer's brochure, certification, test, copy of standard operating instruction, manual, extra stock, guarantee or warranty is required, the appropriate submittal is required regardless of whether it is specified as a "submittal"; the Architects' or Engineers' decision shall be final.

1.5 SUBSTITUTIONS

- A. Substitutions: Plumbing submittals are not opportunities for gaining acceptance of substitutions. Where three or more manufacturers are specified by name, or by catalog reference, Contractor shall select for use any of those so specified.
- B. Should the Contractor desire to substitute another manufacturer's equipment for one specified by name, the Contractor shall apply in writing at least ten (10) days prior to bid date for such permission. He shall provide supporting data and samples for Engineers consideration. No substitution shall be made for any material, article, or process required under the contract unless approved by the Engineer.
- C. Any time that is required by the Engineer for a request to review submittals for substitute

equipment after the award of bids will be billed to the Contractor at the Engineers current hourly billing rate. The Engineers review time will be billed to the Contractor whether the proposed substitution is accepted or rejected.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Submit two (2) sets of 8½" x 11" text sixty (60) days prior to operator training/pre-final inspection bound in three D side-ring capacity expansion binders with durable plastic covers for review by the Professional.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on thirty (30) pound white paper.
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Professional, Contractor, Subcontractors, and equipment suppliers.
 - 2. Part 2: Project documents and certificates, including the following:
 - All approved Submittals
 - Certificates of Compliance
 - Photocopies of warranties and bonds
 - Material safety data sheets
- E. Submit five (5) copies of completed volumes in final form fifteen (15) days prior to owner training. These copies will include Professional's previous review comments.
- F. Submit eight final volumes revised, within ten (10) days after pre-final observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

PLUMBING SUBMITTALS

TABLE A - Shop Drawings Required

Shop Drawings and Submittals Required for this Project	Date Submitted by Contractor	Date Received by Engineer	Date Returned by Engineer	Status (Approved, Approved as Noted, Rejected, etc...)
22 05 01 – Plumbing General				
22 05 32 - Firestopping				
22 05 53 – Identification for Plumbing Piping and Equipment				
22 11 01 – Plumbing Piping				
22 11 02 – General Duty Valves for Plumbing Piping				
22 11 03 – Plumbing Insulation				
22 11 04 – Hangers and Supports for Plumbing Piping and Equipment				
22 24 01 – Domestic Water System and Specialties				
22 11 23 – Facility Natural Gas Piping				

I have reviewed the shop drawings and submittals listed above for compliance with the contract documents.

Contractor's Signature

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Valve Tags.
 - 3. Warning Tags.
 - 4. Stencils.
 - 5. Pipe markers.
 - 6. Ceiling markers.
- B. Related Sections:
 - 1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.3 REFERENCES

- A. Refer to Section 22 05 01 for complete listing of references.

1.4 SUBMITTALS

- A. Section 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Samples: Submit two (2) of each valve tag, label, pipe marker, and ceiling marker, size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.
- B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Safety Sign Co.
 - 3. Seton Identification Products
 - 4. Brady Worldwide

2.2 VALVE TAGS

- A. Plastic Tags:
 - 1. Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1½-inches in diameter or 1½-inches square.
 - 2. Fasteners: Brass beaded chain.
- B. Metal Tags:
 - 1. Brass, Aluminum, or Stainless Steel with stamped letters; tag size minimum 1½-inches in diameter or 1½-inches square with finished edges and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain.

2.3 WARNING TAGS

- A. Information Tags:
 - 1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3¼ x 5-5/8-inches with grommet and self-locking nylon ties.

2.4 STENCILS

- A. Stencils: With clean, die-cut symbols and letters of following size:
 - 1. Up to 2-inches Outside Diameter of Insulation or Pipe: ½-inch high letters.
 - 2. 2½ to 6-inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6-inches Outside Diameter of Insulation or Pipe: 1¾-inches high letters.
 - 4. Equipment: 1¾-inches high letters.
- B. Stencil Paint: As specified in Division 09, semi-gloss enamel, colors and lettering size, conforming to ASME A13.1.

2.5 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
 - 1. Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 - 2. 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.
 - 3. Lettering Size: At least 1½-inches high.
- B. Plastic Pipe Markers:
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.6 CEILING MARKERS

- A. Description: Laminated three-layer plastic with 1/8-inch minimum engraved black letters on white background or color matching lay-in ceiling grid.
 - 1. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
 - 2. Match description used on Equipment Label or Valve Tag.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify all piping has been insulated, painted and/or installed prior to beginning of identification installation.
- B. Coordinate pipe service and direction of flow with installing contractor.
- C. Degrease and clean surfaces to receive adhesive for identification materials.
- D. Prepare surfaces in accordance with Division 09 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Division 09. All painting shall be done in a careful, neat and workmanlike manner, with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide a bond for new paint. All painted surfaces under this Contract shall be finished in an acceptable manner.

- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Identify valves in main and branch piping with tags.
 - 1. In buildings where existing piping systems are modified, the new valve tag numbers and list shall be coordinated with existing valve tag numbers and lists; and, those supplied under other contracts, if applicable.
- F. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure (where applicable). Install in clear view and align with axis of piping.
 - 1. On straight runs of piping at intervals not exceeding 10-feet
 - 2. Within 2-feet of all elbows
 - 3. Within 2-feet of all piping as it passes through partitions (markers provided on both sides of partitions)
- G. Provide ceiling markers to locate valves and equipment. Above T-bar type panel ceilings locate on ceiling grid closest to equipment. At access panels locate on frame or door of access.

END OF SECTION

SECTION 221101 - PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. 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.

1.2 SECTION INCLUDES

- A. Work in this Section includes the following:
 - 1. Domestic Water System
 - 2. Sanitary Waste and Vent Systems

1.3 RELATED SECTIONS

- A. All sections of the Project Manual apply to this section.
- B. Refer to the following specification sections for specifics relating to the plumbing utility systems.
 - 1. 22 05 53 Identification for Plumbing Piping and Equipment
 - 2. 22 11 02 General-Duty Valves for Plumbing Piping
 - 3. 22 11 03 Plumbing Insulation
 - 4. 22 11 04 Hangers and Supports for Plumbing Piping and Equipment
 - 5. 22 24 01 Domestic Water System and Specialties

1.4 REFERENCES

- A. Refer to Section 22 05 01 for complete listing of references.

1.5 SUBMITTALS

- A. Submittals shall be in accordance with Section 22 05 02 – Shop Drawings and Submittals.
- B. The Contractor shall submit manufacturer's catalog data for the following:
 - 1. Domestic Water System
- C. The Contractor shall submit Certificates of Compliance for the following:
 - 1. Schedule of UL listed through penetration assemblies

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L hard drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

- B. Copper Tubing: ASTM B88, Type L hard drawn, rolled grooved ends.
 - 1. Fittings: ASME B16.18 cast copper alloy, or ASME B16.22 wrought copper and bronze, or ASTM B584 bronze sand castings, grooved ends.
 - 2. Joints: Grooved mechanical couplings meeting ASTM F1476.
 - a. Housing Clamps: ASTM A395 and ASTM A536 ductile iron, enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.
 - b. Gasket: Elastomer composition for operating temperature range from 40 degrees F to 200 degrees F.
 - c. Accessories: Steel bolts, nuts, and washers.

PART 3 - EXECUTION

3.1 GENERAL

- A. All materials, equipment and accessories specified in this section shall be installed in strict accordance with the manufacturers' recommendations.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements 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 on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- 2. Existing Piping: Use the following:
 - a. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - b. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - c. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - d. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - e. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire-stop materials. Refer to Division 07 Section "Penetration Fire-stopping" for materials.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 PIPING JOINT CONSTRUCTION
 - A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs.
 - 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. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 3.4 PIPING CONNECTIONS
 - A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2½ and larger, adjacent to flanged valves and at final connection to each piece of equipment.
- 3.5 PIPING INSTALLATION

A. General

1. All piping in finished areas shall be run concealed. The Contractor shall furr in piping or provide soffit as required and in accordance with the Professional's instructions. All piping shall be installed as required to suit space available in building structure, above suspended ceilings, and other locations found necessary for installation.
2. The Contractor shall not install any piping that will interfere with any lights, openings, doors, windows, ductwork, equipment, and existing or special conditions. Headroom in front of openings, doors, or windows shall not be less than the top of the opening. Provide all piping offsets necessary to avoid interferences with other work. Piping offsets shall include all devices and assemblies necessary to accommodate the change in direction of the piping.
3. All piping shall run straight with no more couplings and joints than necessary, shall be grouped wherever practical and shall be carefully installed to provide for proper alignment slope and expansion
4. Pipes carrying fluids shall not be installed in transformer vaults, electrical equipment rooms, elevator hoistways, elevator equipment rooms, or similar areas having a collection of electrical equipment. Pipes shall not be installed over, around, in front of, in back of, or directly below, electrical controls, panels, switches, terminals, boxes, or similar electrical equipment.
5. All piping shall be installed with a minimum of 2-inches between finish covering of pipe and all other work or piping.
6. All piping shall have shut-off valves at all branch connections to mains.
7. Reduction in sizes of pipes shall be made with reducing fittings. Bushings will not be permitted.
8. Bullhead connections in any piping service are prohibited.
9. All screwed joints shall be made with a non-corrosive, non-hardening compound or Teflon tape applied on the male thread only. All compounds must be approved for the pipe on which they are used. Pipe ends shall be reamed or filed out to size of bore and all chips and cuttings removed. Ends of pipe must be cut square so as to seat in the bottom of the recess in drainage fittings. In making joints in chromium plated brass pipe no more than one thread shall remain exposed when joint is completed. Caulking of screwed joints is not permitted. Pipe joint cement and paint will be permitted only on external threads.
10. All soldered joints shall be made with fittings specified. Copper tube and brass pipe, valves, unions, flanges, fittings, and connections shall be joined by means of lead free solder. Ends of all pipes and inside surfaces of fittings shall be cleaned, burnished and tinned before solder is applied. All joints in tubing 2-inches and larger shall be tinned and then soldered with a circular type flame torch.
11. Pull joints, saddle type joints, and "T-Drill" type connections are prohibited.

B. Pressure Piping

1. Branch piping shall be as indicated, but shall be a minimum $\frac{3}{4}$ -inch in nominal size with the last ten feet to each $\frac{1}{2}$ -inch outlet fixture a minimum of $\frac{1}{2}$ -inch in nominal size or where indicated.

2. Each water piping system within the building shall be properly arranged and graded to low points where the entire system can be emptied through a drain.
3. Drain Valves - Furnish and install a ½-inch rough brass hose bibb with female hose connection, cap and chain at all low points of the domestic water piping systems. The hose bibb shall be located so as to be accessible and easily operable, and so that a hose can be connected to the outlet.
4. Exposed piping at fixture rough-in shall be chrome plated brass (from insulation to fixture or equipment connection).

3.6 PROTECTION AGAINST PHYSICAL DAMAGE

- A. In concealed locations, where piping, other than cast-iron or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1¼-inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16-inch thick steel, shall cover the area of the pipe where the member is notched or bored and shall extend a minimum of 2-inches above and below top plates.

END OF SECTION

SECTION 22 11 02 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
 - 2. Check valves.
- B. Related Sections:
 - 1. Section 22 11 01 - Plumbing Piping: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 22 11 03 - Plumbing Insulation: Product and installation requirements for insulation for valves.
 - 3. Section 22 11 04 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for pipe hangers and supports.
 - 4. Section 22 24 01 - Domestic Water System and Specialties: Product and installation requirements for piping, piping specialties, and equipment used in domestic water systems.

1.3 REFERENCES

- A. Refer to Section 22 05 01 for complete listing of references.

1.4 SUBMITTALS

- A. Section 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with City of Durham Standard.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience [approved by manufacturer].

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish one year manufacturer warranty for valves excluding packing.

1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish 2 packing kits for each size valve.

PART 2 - PRODUCTS

2.1 BALL VALVES

- A. Manufacturers:
 - 1. Conbraco Industries, Inc.; Apollo Valve
 - 2. Crane Valve, North America
 - 3. Hammond Valve
 - 4. Milwaukee Valve Company
 - 5. NIBCO, Inc.
 - 6. Stockham Valves & Fittings
- B. 2 1/2-inches and Smaller: MSS SP 110, 600 psi WOG three-piece bronze body, stainless steel ball, full port, teflon seats, blow-out proof stem, threaded ends locking lever handle.

2.2 CHECK VALVES

- A. Horizontal Swing Check Valves:

1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
 2. 2-inches and Smaller: MSS SP 80, Class 125 (200 CWP), bronze body and cap, bronze seat, Buna-N disc, threaded ends.
- B. Spring Loaded Check Valves:
1. Manufacturers:
 - a. Crane Valve, North America
 - b. Hammond Valve Model
 - c. Milwaukee Valve Company
 - d. NIBCO, Inc.
 - e. Stockham Valves & Fittings
 2. 2-inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, threaded ends.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.
 1. 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.
 2. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
 3. Examine threads on valve and mating pipe for form and cleanliness.
 4. 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.
 5. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install valves in position to allow full stem movement.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install 3/4-inch ball valves with cap for drains at main shut-off valves, low points of piping, bases

of vertical risers, and at equipment.

- E. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- F. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Division 08.
- G. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
- H. Refer to Section 22 11 04 for pipe hangers.
- I. Refer to Section 22 11 03 for insulation requirements for valves.
- J. Refer to Section 22 11 01 for piping materials applying to various system types.
- K. For installation of valves in domestic water systems refer to Section 22 24 01.
- L. For installation of valves in general service compressed air systems refer to Section 22 24 03.
- M. For installation of valves in sanitary systems refer to Section 22 25 01.

3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section or as required.
- B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.4 ADJUSTING

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

END OF SECTION

SECTION 22 11 03 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Piping system insulation.
 - 2. Pipe insulation jackets.
 - 3. Insulation accessories including vapor retarders and accessories.
- B. Related Sections:
 - 1. Division 07 - Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Division 09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
 - 3. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for plumbing piping and equipment identification.
 - 4. Section 22 11 04 - Hangers and Supports for Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.

1.3 REFERENCES

- A. Refer to Section 22 05 01 for complete listing of references.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures and 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.

7. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.

1. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Perform Work in accordance with State, Federal and local standards.

C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

D. Maintain one (1) copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three (3) years documented experience [approved by manufacturer].

1.7 PRE-INSTALLATION MEETINGS

A. Division 01 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one (1) week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Division 01 - Product Requirements: Environmental conditions affecting products on site.

B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

C. Maintain temperature during and after installation for minimum period of 24 hours.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Certain Teed Corporation
- B. Johns Manville Co.
- C. Knauf Fiberglass GmbH
- D. USG Interiors, Inc. – Thermafiber Division
- E. Owens-Corning Fiberglass Corporation

2.2 INSULATION MATERIALS

- A. Comply with requirements in Part 3 match existing insulation where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricated shapes according to ASTM C 450 and ASTM C 585.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.

- d. Manson Insulation Inc.; Alley-K.
- e. Owens Corning; Fiberglas Pipe Insulation.
- 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-97.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
 - c. Marathon Industries, Inc.; 290.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-96.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.

- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Red Devil, Inc.; Celulon Ultra Clear.
 - e. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.

- c. Marathon Industries, Inc.; 130.
- d. Mon-Eco Industries, Inc.; 11-30.
- e. Vimasco Corporation; 136.
- 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
- 3. Service Temperature Range: Minus 50 to plus 180 deg F.
- 4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

- 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Permanently flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 100 to plus 300 deg F.
- 5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
 5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED JACKETS

- A. Insulation jackets in this article are for field application. ASTM C 921, Type I, is for use over insulation on equipment and pipes operating at below ambient temperatures at least part of the time or where a vapor barrier is required. ASTM C 921, Type II, is for use over insulation on pipes operating above ambient temperatures or where a vapor retarder is not required.
- B. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.

- b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3-inches.
 3. Thickness: 11.5-mils.
 4. Adhesion: 90-ounces force/inch in width.
 5. Elongation: 2-percent.
 6. Tensile Strength: 40-lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
|
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2-inches.
 3. Thickness: 6-mils.
 4. Adhesion: 64-ounces force/inch in width.
 5. Elongation: 500-percent.
 6. Tensile Strength: 18-lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 2. Width: 2-inches.
 3. Thickness: 3.7-mils.
 4. Adhesion: 100-ounces force/inch in width.
 5. Elongation: 5-percent.
 6. Tensile Strength: 34-lbf/inch in width.
- D. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3-inches.
3. Film Thickness: 4-mils.
4. Adhesive Thickness: 1.5-mils.
5. Elongation at Break: 145-percent.
6. Tensile Strength: 55-lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
5. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
6. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely

in position indicated when self-locking washer is in place. Comply with the following requirements:

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
7. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
8. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
9. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO.

2) Midwest Fasteners, Inc.

- B. Staples: Outward-clinching insulation staples, nominal $\frac{3}{4}$ -inch- wide, stainless steel or Monel.
- C. Wire: 0.062-inch soft-annealed, stainless steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 x 1-inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 x 1-inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 x 1-inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 INSTALLATION

- A. Exposed Piping: Locate insulation and cover seams in least visible locations.
- B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- C. Man made mineral fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness

- as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment
 - E. Man made mineral fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - F. Inserts and Shields:
 - 1. Application: Piping 1½-inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under finish jacket.
 - 4. Insert configuration: Minimum 6-inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - 5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.
 - G. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Division 07 for penetrations of assemblies with fire resistance rating greater than one hour.
 - H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 8- feet above finished floor): Finish with aluminum jacket or stainless steel jacket.
 - I. Factory Insulated Equipment: Do not insulate.
 - J. Exposed Equipment: Locate insulation and cover seams in least visible locations.
 - K. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - L. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - M. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
 - N. Mineral fiber insulated equipment containing fluids below ambient temperature: Provide vapor retarder jackets, factory-applied or field-applied. Finish with glass-cloth and vapor barrier adhesive.
 - O. Mineral fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.
 - P. Finish insulation at supports, protrusions, and interruptions.
 - Q. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

- R. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- S. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.4 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.5 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to on location of straight pipe, one locations of threaded fitting, and one location of threaded valve for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.6 SCHEDULES

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
- C. Plumbing Systems
 - 1. Domestic Cold Water:
 - a. 1 NPS and smaller:
 - 1) Man Made Mineral Fiber Insulation: 1-inch
 - 2) Cellular Glass Insulation: 1½-inch
 - 3) Cellular Phenolic Foam Insulation: 1-inch

END OF SECTION

SECTION 22 11 04 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

- A. General Conditions of the Contract, Special Conditions, Instructions to Bidders, and other General Requirements contained in Division 00 and 01 are a part of these Specifications.
- B. 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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Sleeves.
 - 6. Escutcheons
 - 7. Formed steel channel.
 - 8. Firestopping relating to plumbing work.
 - 9. Firestopping accessories.
- B. Related Sections:
 - 1. Section 22 05 01 - Common Work Results for Plumbing
 - 2. Section 22 24 01 - Domestic Water System and Specialties

1.3 REFERENCES

- A. Refer to Section 22 05 01 for complete listing of references.

1.4 DEFINITIONS

- A. Fire-stopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Fire-stopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM or UL requirements.
- B. Surface Burning: ASTM E84 UL 723 with maximum flame spread / smoke developed rating of 25/50.
- C. Fire-stop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Fire-stopping: Conform to applicable code (FM or UL) for fire resistance ratings and surface

burning characteristics.

- B. Fire-stopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Section 22 05 02 – Plumbing Shop Drawings and Submittals, Substitutions and O&M Manuals: Submittal procedures.
- B. Shop Drawings:
 - 1. Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers, metal framing systems, pipe stands and/or equipment supports.
 - 2. Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Fire-stopping: Submit data on product characteristics, performance and limitation criteria.
- D. Fire-stopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Welding certificates.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.
- B. Through Penetration Fire-stopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with City of Durham.
- H. Maintain one (1) copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

1.10 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products
- B. Do not apply fire-stopping materials when temperature of substrate material and ambient air is below 60-degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3-days after installation of fire-stopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.14 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Provide all miscellaneous steel required for support of pipes and equipment other than steel shown on Structural Engineer's drawings.
- B. Pipe hanger design, materials, and manufacturer shall conform to the requirements defined in MSS SP58-88.
- C. The selection and spacing of pipe hangers shall comply with the data included in MSS SP69-91.
- D. All hanger materials including clevis hangers, rods, inserts, clamps, stanchions, brackets, shall have a factory applied finish of electro-plated zinc, unless noted otherwise.
- E. Hangers, clamps and supports for use on un-insulated copper piping shall be provided with inserts to isolate the copper piping from the hanger. Inserts shall be made of felt or plastic and shall be as manufactured by the hanger manufacturer.
- F. Insulated piping shall be provided with insulation shields. Hanger shall be sized to include piping diameter and insulation thickness.
- G. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Carpenter & Paterson Inc.
 - 3. ERICO/Michigan Hanger Co.
 - 4. Globe Pipe Hanger Products Inc.
 - 5. Grinnell Corp.
 - 6. MIRO Industries, Inc.
 - 7. PHD Manufacturing, Inc.
 - 8. Tolco Inc.
 - 9. Unistrut Corp.; Tyco International, Ltd.
- H. Hanger Materials:
 - 1. Horizontal Sanitary, Waste and Vent Piping:
 - a. 3-inch and smaller:
 - 1) B-Line B3100
 - 2) Anvil 260
 - 3) PHD 450
 - b. 4-inch and larger:
 - 1) B-Line B3102
 - 2) Anvil 590
 - 3) PHD 420
 - 2. Horizontal Domestic Water Piping:
 - a. 2-inch and smaller:
 - 1) B-Line B3100

- 2) Anvil 260
 - 3) PHD 450
 - b. 2½-inch and larger:
 - 1) B-Line B3100
 - 2) Anvil 260
 - 3) PHD 450
 - c. AWWA piping:
 - 1) B-Line B3102
 - 2) Anvil 590
 - 3) PHD 420
- 3. Insulation Shields
 - a. All Piping:
 - 1) B-Line B3155
 - 2) Anvil 168
 - 3) PHD 160
- 4. Connectors:
 - a. Beam Clamps:
 - 1) B-Line B3033, B3050, B3291-B3297
 - 2) Anvil 88, 133, 134 or 292S
 - 3) PHD 360, 620
 - b. Concrete inserts:
 - 1) B-Line B2500, B3014
 - 2) Anvil 282, 285
 - 3) PHD 950
 - c. Welded beam attachments:
 - 1) B-Line B3083
 - 2) Anvil 66
 - 3) PHD 900
 - d. Piping adjacent to walls or steel columns, brackets:
 - 1) B-Line
 - 2) Anvil No. 194, 195, or 199 depending on weight to be supported.
 - 3) PHD
 - e. Base supports:
 - 1) B-Line

- 2) Anvil Figure No. 259, or 264.
 - 3) PHD
 - 5. Hanger Rods:
 - a. Hanger rod:
 - 1) B-line
 - 2) Anvil Figure No. 140.
 - 3) PHD
 - b. Continuous threaded rod:
 - 1) B-line
 - 2) Anvil Figure No. 146.
 - 3) PHD
 - c. Eye Rods:
 - 1) B-line
 - 2) Anvil Figure No. 248
 - 3) PHD
 - 6. Trapeze Hangers:
 - a. Direct Mounting Hangers:
 - 1) B-line
 - 2) Anvil Figure No. 46
 - 3) PHD
- 2.2 ACCESSORIES
 - A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- 2.3 INSERTS
 - A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- 2.4 FLASHING
 - A. Metal Flashing: 26 gage thick galvanized steel.
 - B. Metal Counter Flashing: 22 gage thick galvanized steel.
 - C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
 - D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
 - E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.
- 2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Sleeve in paragraph below is available with many end variations.
- D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 MECHANICAL SLEEVE SEALS

- A. Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12-gage thick steel. With holes 1½-inches on center.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.

B. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive fire-stopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission from the Professional before using powder-actuated anchors.
- E. Do not drill or cut structural members.

3.3 INSTALLATION – INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4-inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and/or MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum ½-inch space between finished covering and adjacent work.
- D. Place hangers within 12-inches of each horizontal elbow.
- E. Use hangers with 1½-inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5-feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze

hangers.

- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and/or support between hanger and/or support and bare copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 11 03.

3.5 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3-inches minimum above finished roof surface with lead or material compatible with roofing worked 1-inch minimum into hub, 8-inches minimum clear on sides with 24 x 24-inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10-inches clear on sides with minimum 36 x 36-inch sheet size. Fasten flashing to drain clamp device.
- D. Seal drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1½-inches above finished floor level. Caulk sleeves. Extend sleeves through floors 3-inches above finished floor level in Kitchen or wet-areas.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with fire-stopping insulation and caulk water tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION – FIRE-STOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring fire-stopping.
- B. Apply primer where recommended by manufacturer for type of fire-stopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply fire-stopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Fire Rated Surface:

1. Seal opening at floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - e. Where piping penetrates fire rated surface, install fire-stopping product in accordance with manufacturer's instructions.

E. Non-Rated Surfaces:

1. Seal opening through non-fire rated floor as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Install type of fire-stopping material recommended by manufacturer.
2. Install escutcheons where piping, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3.8 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements or - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed fire-stopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of fire-stopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.11 SCHEDULES

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
CPVC, 1 inch and smaller	3	1/2
CPVC, 1-1/4 inches and larger	4	1/2
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
Polypropylene	4	3/8
PVC (All Sizes)	4	3/8
Steel, 3 inches and smaller	12	1/2
Steel, 4 inches and larger	12	5/8

END OF SECTION

SECTION 22 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 SCHEDULE 40 BLACK STEEL PIPE

- A. Design Pressure: 150 psig.
- B. Maximum Design Temperature: 350 degrees F.

C. Sizes 2-1/2 inches and smaller:

1. Pipe: Schedule 40 black steel, threaded and coupled, ASTM A53.
2. Joints: Threaded. (Exception: All gas piping installed in steel conduits; all gas conduit and conduit vent pipe; all black steel pipe installations below ground; shall be continuous butt weld joints.)
3. Fittings: 150 lb. (S) 300 lb. (WOG) black malleable iron.
4. Unions: 250 lb. (S) 500 lb. (WOG) black malleable iron, ground joint with brass seat.

2.2 CORRUGATED, STAINLESS-STEEL TUBING: SPECIFICATION NO. 2

A. Comply with ANSI/IAS LC 1

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 450 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 5 psig.

2.3 ANNEALED-TEMPER COPPER TUBE:

A. Comply with ASTM B 88, Type K.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.

2.4 UNDERGROUND POLYETHYLENE NATURAL GAS PIPE

A. Polyethylene Pipe: ASTM D2513, SDR11.5

1. Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. Joints: Fusion welded.
3. Manufacturer of pipe shall be approved by local gas company.
4. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
5. Anodeless Service-Line Risers: Factory fabricated, and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
6. Transition Service-Line Risers: Factory fabricated, and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
 - b. Outlet shall be threaded or suitable for welded connection.
 - c. Bridging sleeve over mechanical coupling.
 - d. Factory-connected anode.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.5 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.

5. Operating-Pressure Rating: 0.5 psig.
 6. End Fittings: Zinc-coated steel.
 7. Threaded Ends: Comply with ASME B1.20.1.
 8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
 2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- C. 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.
 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.6 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.7 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 psig.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.

6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Regular-Port Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig.
 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 2. Body: Bronze, complying with ASTM B 584.
 3. Plug: Bronze.
 4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Operator: Square head or lug type with tamperproof feature where indicated.
 6. Pressure Class: 125 psig.
 7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kerotest Manufacturing Corp.
 - b. Lyall, R. W. & Company, Inc.
 - c. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: PE.
 3. Ball: PE.
 4. Stem: Acetal.
 5. Seats and Seals: Nitrile.
 6. Ends: Plain or fusible to match piping.
 7. CWP Rating: 80 psig.
 8. Operating Temperature: Minus 20 to plus 140 deg F.
 9. Operator: Nut or flat head for key operation.
 10. Include plastic valve extension.
 11. Include tamperproof locking feature for valves where indicated on Drawings.
- G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.8 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.9 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and

same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- U. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 5. 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.
- D. Welded Joints:
1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
 2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and flared joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
 - 3. Steel pipe with malleable-iron fittings and threaded joints.

- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping gas mains and listed by an NRTL.
- B. Underground: PE OR Bronze plug valves.

3.12 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, regular-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

END OF SECTION

DIVISION 23 – MECHANICAL SPECIFICATIONS
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SECTION 23 01 00 – MECHANICAL GENERAL

PART 1 GENERAL REQUIREMENTS

1.1 DEFINITIONS

- A. Piping: Pipe, fittings, flanges, valves, controls, hangers, supports, traps, drains, gauges, insulation, vents and items customarily required in connection with the transfer of fluids.
- B. Ductwork: All air distribution, re-circulation and exhaust ducts, whether of sheet metal or other material, and includes all connections, hanger, supports, damper controls, insulation, accessories, fire and smoke control devices, and appurtenances necessary for and incidental to a complete system.
- C. Provide: Furnish and install complete ready for use.
- D. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance and for installation.
- E. Install: Unload at the delivery point and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.
- F. Concealed: Embedded in masonry or other construction, installed behind wall furring, above ceilings, in crawl spaces, in shafts or otherwise not visible.
- G. Exposed: Not concealed.
- H. By other Trades: Shall mean by persons or parties who are not anticipated to be the Subcontractor for this trade working together with the Prime Contractor. In this context the words “by other trades” shall be interpreted to mean not included in the overall contract.
- I. Contractor: As used in this Division of the specification refers to the Mechanical Contractor unless specifically noted otherwise.

1.2 INTERPRETATION OF CONTRACT DOCUMENTS

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 23.
- B. Attention is directed to, General Conditions, which are binding in their entirety on this portion of the work and in particular to paragraphs concerning materials, workmanship and substitutions.
- C. Mention in these specifications, indications and reasonable implications on drawings, whereby articles, materials, operation or methods related to execution of the mechanical work are noted, specified, drawing or described, thereby requires execution of each such item of work and provision of all labor, materials, equipment and appurtenances required for execution thereof.
- D. Particular attention is directed to the drawings and other contract documents for information pertaining to required items or work which are related to and usually associated with the work of this Division of the specifications, but which are to be provided as part of the work of other Divisions of the specifications.
- E. No exclusions from, or limitations in, the language used in the drawings or specifications shall be interpreted as meaning that the appurtenance or accessories necessary to complete any required system or item of equipment are to be omitted.
- F. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on

final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded. When abbreviations appear on the drawings or specifications in lower case letter with or without periods, their meanings shall be the same as stated above.

- G. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field coordination for the indicated work.
- H. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.
- I. The use of words in the singular shall be considered as limited where other indications denote that more than one item is referred to.
- J. Submission of a proposal and ultimate acceptance of an agreement or contract for execution of this section of work will be construed as evidence that the Prime Contractor, Subcontractor and Vendor has carefully read and accepts all conditions set forth in each division. insofar as such conditions may affect both the bidding for and execution of this section of work.

1.3 QUALITY ASSURANCE AND WARRANTY

- A. The Contractor shall guarantee all work, materials and equipment furnished against defects, leaks, performance and non-operation for a period of one (1) year after the date of the Owner's final acceptance, or as indicated in the General Conditions. Warranties to extend past this date are defined in individual equipment specification sections. Defects shall be interpreted as defective materials or equipment or unsatisfactory installation and are not intended to apply to ordinary wear and tear. The Contractor shall pay for any repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency.
- B. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacturers of said equipment for a minimum of three (3) years and, if so directed by the Designer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
- C. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. UL or other labels, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- D. All equipment of one type (such as fans, pumps, valves, grilles, etc.) shall be the products of one manufacturer unless specifically stated otherwise.
- E. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- F. All welders shall be certified by the National Certified Pipe Welding Bureau for the appropriate service, and shall perform all welding in accordance with Welding Bureau's procedures and the

ASA Code for pipe welding. Welding and welder qualifications shall be in accordance with ASME Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractors shall submit to the appropriate Regulatory Agencies all items necessary to obtain all required permits, obtain such required permits and pay all required fees.
- B. All work shall conform to the following Standards and Codes (applicable edition):
 - 1. North Carolina State Building Code.
 - 2. National Fire Protection Association.
 - 3. Uniform Boiler and Pressure Vessel Act of N.C. (Boiler Code)
- C. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM).
 - 2. Underwriters Laboratories, Inc. (UL).
 - 3. CSA
 - 4. ETL
 - 5. AGA
 - 6. AWWA
- D. All fuel fired equipment shall meet the requirements of the agencies listed and also meet the Owner's insurer requirements.

1.5 STANDARDS AND PROCEDURES:

- 1. ADC: Air Diffusion Council.
 - 2. AMCA: Air Moving and Conditioning Association, Inc.
 - 3. ANSI: American National Standards Institute.
 - 4. API: American Petroleum Institute.
 - 5. ARI: American Refrigeration Institute.
 - 6. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - 7. ASME: American Society of Mechanical Engineers.
 - 8. ASTM: American Society of Testing and Materials.
 - 9. IBR: Institute of Boiler and Radiator Manufacturers.
 - 10. MSS: Manufacturers Standardization Society.
 - 11. NEMA: National Electrical Manufacturer's Association.
 - 12. OSHA: Occupational Safety and Health Administration.
 - 13. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
- B. Where reference is made to ASA Standards it shall be understood that this reference is to the standards published by ANSI.

- C. Include all items of labor and materials required to comply with such standards and codes. Where quantity, sizes or other requirements indicated on the drawings or herein specified are in excess of the standard or code requirements, the specifications or drawings, respectively, shall govern.

1.6 EQUIVALENT PRODUCTS:

- A. Notwithstanding any reference in the specifications to any article, device, product, materials, fixture, form or type of construction by name, make, or catalog number, such references shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition and the Contractor, in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the Designer, expressed in writing, is equal to that specified.
- B. Requests for written approval to substitute materials or equipment considered by the contractor as equal to those specified shall be submitted for approval, to the Engineer, in accordance with SUBSTITUTIONS section.

1.7 VERIFICATION OF DIMENSIONS AND LOCATIONS:

- A. The Contractor shall visit the premises and thoroughly familiarize himself with all details of the work, working conditions, verify all dimensions in the field, advise the Designer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install all equipment in a manner to avoid building interference.
- B. The location of duct, pipe, fixture, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.

1.8 COORDINATION WITH OTHER TRADES:

- A. Coordinate all work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings, and shall make sure that proposed equipment can be accommodated. If interferences occur and clearances cannot be maintained as recommended by manufacturer and as required for maintenance and inspection of equipment, Contractor shall bring them to the attention of Designer, in writing, prior to signing of contract; or, Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.
- B. Prepare composite coordination drawings at a scale of $\frac{1}{4}" = 1'-0"$ or larger, detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components (For all floor levels including all mechanical areas, penthouses, and roof plans. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. The Mechanical Contractor will administer the effort of coordination between various trades. The coordination drawings will be prepared and reviewed approved by Engineer of Record and CxA before installation of any plumbing, sprinkler, mechanical or electrical work and will be shown as a task on the Project Schedule to be prepared by the General Contractor.

1.9 WORKMANSHIP

- A. Workmen to be thoroughly experienced and fully capable of installing assigned work. Work to be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner and as approved.

- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations (using recommended accessories) and/or as approved by the Designer. Retain a copy on job site and submit others for approval when required.

PART 2 PRODUCTS

This Part Not Used

PART 3 EXECUTION

3.1 SURFACE CONDITIONS:

- A. Inspection:
 - 1. Prior to any work, the Contractor shall carefully inspect the installed Work of all other Trades and verify that all such Work is complete to the point where his installation may properly commence.
 - 2. Verify that all equipment may be installed in accordance with all pertinent codes and regulations, the original design and the referenced standards.
- B. Discrepancies:
 - 1. In the event of discrepancy, immediately notify the Designer.
 - 2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

3.2 INSTALLATION

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations.

3.3 REQUIREMENTS FOR OPERATING HVAC EQUIPMENT DURING CONSTRUCTION

- A. Building must be fully enclosed, including installation of all doors, windows, etc.
- B. Set air handler to use 100% outside if construction is still generating dust and when conditions will not allow the coil to freeze.
- C. If return air is to be used then all exhaust and return ducts/grilles shall be covered with temporary filter media, minimum MERV 8, to prevent dust infiltration into the ducting.
- D. All chilled water piping shall be insulated.
- E. Pump and fans shafts shall be aligned prior to operation. Laser alignment shall be provided for pumps, and reports shall be furnished prior to operation.
- F. Supply and outside air connections of ductwork to AHUs shall be complete.
- G. All manual dampers, fire dampers and combination fire/smoke dampers shall be open.
- H. All main supply ductwork shall be insulated.
- I. All safety circuits and basic control functions shall be active and fully functional. If the equipment may operate without a fully functional BAS, then means to prevent damage to ducting due to closed dampers and means to prevent damage to freezing coils shall be provided. Blow-out doors may be used to protect ducting. Until TAB activities commence, fans and pumps shall operate at no more than 70% of estimated design capacity.
- J. Conditioning (cooling & dehumidifying) of the building shall remain once started.

- K. Final approval of Engineer and Owner are required prior to starting AHUs for temporary operation.
- L. Cover outside air intakes with 1" roll filter media.
- M. The contractor shall perform all required preventative maintenance on mechanical equipment operated during construction and provide documentation in the operation and maintenance manuals of preventative maintenance activities completed during this period.
- N. At the end of the construction period and prior to occupancy, clean the inside of AHUs and if more than 50% loaded, then install new pre and final filters.
- O. All specified filters shall be installed during all AHU operation.

3.4 PROTECTION AND CLEANING OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, the Contractor shall repair or replace damaged items as determined by the Architect/Engineer, at no cost to the Owner.
- B. Damage from rain, dirt, sun, and ground water shall be prevented by storing the equipment on elevated supports and covering them on all sides with securely fastened protective rigid or flexible waterproof coverings.
- C. Piping shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of all ductwork and piping installed vertically.
- E. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of all packing material and debris. All adjacent occupied areas shall be cleaned daily to remove dirt and debris resulting from this work.

3.5 WELDING AND PIPING PRESSURE TESTS

- A. All welded piping shall be installed by Contractor using NCPWB or ASME Certified Welding Procedures. Welding shall comply with ANSI/ASME B31.1 and Section IX of the ASME Boiler and Pressure Code.
- B. All piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 150 psig. This hydrostatic test shall be witnessed by the Designer.
- C. Ten days before any welded work is to start, the Contractor shall furnish the Designer copies of the welding procedures approved for the Contractor.
- D. Before any welder is put to work in welding any piping for this job, the Designer shall be furnished with duplicate copies of the certification of each welder. If, in the opinion of the Designer, the welding is not done properly, a coupon shall be cut from field welds for inspection and/or the welder may be required to pass a recertification test. Costs of cutting the coupon shall be the responsibility of the Contractor.
- E. No welding is to be covered with insulation or concealed until the welding has been approved by the Designer as outlined above.
- F. All welding operations shall be approved by the Designer prior to beginning work. Extreme care shall be exercised to prevent damage to the existing buildings or building or surrounding contents during welding operations.
- G. During welding of all piping, contractor shall use fire resistant or equal pad protection to prevent scorching or burning of existing floor and wall finishes, etc. Also, care shall be taken to eliminate

sparks from dropping on existing furniture, equipment and flooring material. All damages created by welding flame or sparks shall be repaired to owner's satisfaction at contractor's expense.

- H. All welding shall be done in such a manner as to prevent welding fumes to enter other areas of the building and shall be coordinated with the owner to assure that it does not interfere with normal building operations while the building is occupied.

3.6 SUBSTITUTION OF EQUIPMENT

- A. Requests for substitutions of products may be made during the bidding period by submitting completed substitution request accompanied by information sufficient for the Engineer to make a determination as to the equivalency of a product.
- B. The Engineer will consider requests utilizing this section for substitution of products in place of those specified.
- C. Submit 14 calendar days prior to Bid Date. No substitutions will be reviewed or accepted after this date unless there is an obvious advantage to the Owner.
- D. Substitution requests may be submitted by email or U.S. Postal Service.
- E. Prime Bidders shall request a substitution on the letterhead stationery of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.
- F. Submit separate requests for each substitution. Support each request with the following information. All items must be addressed.
- G. Complete data substantiating compliance of proposed substitutions with requirements stated in Contract Documents:
 - 1. Product identification, including manufacturer's name and address.
 - 2. Manufacturer's literature, identifying:
 - a) Product description.
 - b) Reference standards.
 - c) Performance and test data.
 - 3. Name and address of similar projects on which product has been used and date of each installation.
 - 4. Itemized comparison of the proposed substitution with product specified, listing significant variations.
 - 5. Data relating to changes in construction schedule, if any.
 - 6. All effects of substitution on separate contracts.
 - 7. List of changes required in other work or products.
 - 8. Designation of availability of maintenance services and sources of replacement parts.
- H. Substitutions will not be considered for acceptance when:
 - 1. Acceptance will require substantial revision of Contract Documents.
 - 2. In judgment of Engineer, substitution request does not include adequate information for a complete evaluation.
 - 3. Requests for substitutions not submitted by a Prime Bidder.
 - 4. Where the effect on the schedule will be negative.

- I. In making formal request for substitution, the Prime Bidder represents that:
 1. The Prime Bidder has investigated proposed product and has determined that it is equivalent to or superior in all respects to that specified.
 2. The Prime Bidder will provide the same warranties or bonds for substitution as for product specified.
 3. The Prime Bidder will coordinate installation of accepted substitution into the Work and will make such changes as may be required for the Work to be complete in all respects.

3.7 SUBMITTALS

- A. Refer to Division 1, as available, for information on submittal requirements. When conflicts exist, Division 1 shall apply.
- B. The terms "Submittals" can generally be used to indicate any information which is required to be reviewed by the A/E before further action on that product can be taken by the Contractor. This may include product data sheets, shop drawings, and schedules.
- C. Submittals generally not required when equipment is purchased exactly as specified and scheduled. Submit list of such equipment only. Equipment data sheets must be included in project manual prepared for Owner.
- D. Submittals shall be searchable format, preferably pdf.

E. PRODUCT SUBMITTALS

1. The following product data information shall be submitted:

Product	Submitted	Approved
Air Filters	_____	_____
Air Handling Units	_____	_____
Air Separator	_____	_____
Air Vents	_____	_____
Boilers	_____	_____
Balancing Fittings	_____	_____
Dampers	_____	_____
Dielectric Fittings	_____	_____
Duct Access Doors	_____	_____
Duct Sealants	_____	_____
Expansion Tank	_____	_____
Fans	_____	_____
Fire Stop Material	_____	_____
Flexible Pipe Connections	_____	_____
Flow Control Fittings/Valves	_____	_____
Hot & Chilled Water Specialties	_____	_____
Insulation, Mastics and Sealants	_____	_____

Pumps	_____	_____
Pressure Gauges	_____	_____
Pressure Reducing, Regulating & Safety Valves	_____	_____
Sheet Metal Specialties	_____	_____
Temperature Controls/BAS	_____	_____
Test Wells, Thermometers	_____	_____
Valves and Strainers	_____	_____
Variable Frequency Drives	_____	_____
Vibration Isolators/Seismic Restraints	_____	_____
VAV Boxes	_____	_____
Water Treatment	_____	_____
Welder Qualifications	_____	_____

F. TEST AND REPORT SUBMITTALS:

The following list may be used as a checklist for the contractor and A/E. All tests may not be listed.

1. TEST

- a) Aboveground HVAC piping pressure/leak test
- b) Duct pressure Test
- c) System start-up
- d) Test and Balance Agency Construction report
- e) All required Test Reports.

G. FIRE PENETRATION SYSTEMS SUBMITTAL:

1. Each type system penetrating a fire rated assembly shall be identified by the Contractor. The Contractor shall demonstrate his understanding of fire stop systems by the following:
2. Submit 3/4 inch scale drawings of each assembly indicating type penetrations, slab, floor, wall or roof system, fire stop materials used, thickness and all other pertinent details. Submittal shall be neatly and accurately drafted.
3. Each type system penetrating a fire rated assembly shall be identified by the Contractor. Provide approved installation details with agency approval indicated thereon.

3.8 RECORD DRAWINGS:

- A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material and equipment of these job drawings.
- B. At the time of final inspection, two corrected sets of prints and sepias shall be delivered to the Designer. All drawing costs to be paid by the Contractor.
- C. Sepias shall be corrected deleting incorrect locations and showing installed locations in accordance with information transferred from job drawing.

D. Qualified draftsmen shall perform this task.

3.9 OPERATION AND MAINTENANCE MANUALS:

- A. The Contractor shall compile and bind three (3) sets of all manufacturer's instructions and descriptive literature on all items of equipment furnished under this work. An electronic PDF copy of the O&M manuals shall also be provided and shall have searchable text.
- B. The manuals shall comply with specifications in this section in addition to specifications in other mechanical specifications as well.
- C. Binder shall be hard cover, three-ring notebook, 11" x 8-1/2" with heavy duty rings. Maximum binder size shall be 2-1/2".
- D. The front of the binder shall be titled "Mechanical Operating and Maintenance Instructions," with the name of the job and documents date under the title.
- E. Operating and Maintenance Instructions shall include the following:
 - 1. A sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.
 - 2. List name, address and phone number of organization responsible for warranty work if other than contractor and the specific work for which he is responsible.
 - 3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
 - 4. Schedules of all equipment indicating identification number shown on plans cross referenced to field applied identification tag number.
 - 5. Performance Curves: For pumps, balance valves and similar equipment at the operating conditions.
 - 6. Lubrication Schedule: Indicating type and frequency of lubrication required.
 - 7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
 - 8. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 - 9. Instruction Books: May be standard booklets but shall be clearly marked to indicate applicable equipment and characteristics.
 - 10. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
 - 11. Automatic Controls: Diagrams and functional descriptions.
 - 12. Test and Balance Reports.
 - 13. Valve tag list: Identifying valve type, size, service and general location.
 - 14. Filter schedule: Identifying filter type, size efficiency, manufacturer and equipment number.
 - 15. Ceiling marker schedule.
- F. The following diagrams, schematics and lists shall be framed under glass and hung adjacent to equipment, in mechanical rooms, or where directed by Owner.
 - 1. Automatic control diagrams.
 - 2. Sequence of operation.

3. Valve Tag List

3.10 OPERATIONAL AND MAINTENANCE INSTRUCTION:

- A. After all final tests and adjustments have been complete, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in all details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time after instructions to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be as follows:
 - 1. Air handling units, Chilled Water, Hot Water, and Steam Systems (1 working day)
- B. Instruction period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner.

3.11 CONTROLS OPERATION AND MAINTENANCE INSTRUCTION:

- A. Upon completion of Operation and Maintenance instructions, competent employees of the Control Contractor shall be provided to instruct the Owner's representative in all details of operation and maintenance for the controls installed. Supply qualified personnel to operate system for sufficient length of time after instructions to assure the Owner's Representative is qualified to take over operation and maintenance procedures.
- B. Controls Operation and Maintenance Instruction shall include the entire control system including control sequences that are inherent to equipment provided by the Equipment Manufacturer including economizer cycles, burner operation, low ambient operation, freezstats and similar sequences. Contractor shall provide sufficient personnel equipment walkie-talkies, gauges, and other accessories for this work.
- C. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive. Minimum instruction periods shall be one (1) working day for on-site training.
- D. Instructional period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner. One (1) day of instructions shall be in a formal classroom setting as determined by the owner.
- E. Classroom instructions shall be video taped by the Contractor. A copy of each tape shall be provided to the Owner. Contractor shall be responsible for all equipment, tapes, and accessories required.

3.12 GENERAL COMPLETION AND DEMONSTRATION:

- A. RESULTS EXPECTED:
 - 1. All systems and controls shall be complete, tested and operational.
 - 2. All start-up and testing and balancing shall be complete.
 - 3. All equipment shall be thoroughly cleaned. All excess materials and all debris shall be removed from the site.
 - 4. All walls, floors, ceilings and other surfaces marred or otherwise damaged as a result of execution of this contract shall be cleaned and repaired to the satisfaction of the Designer and Owner.

END OF SECTION

SECTION 23 02 00 – MECHANICAL RELATED WORK

PART 1 GENERAL REQUIREMENTS

1.1 DRAWINGS AND SPECIFICATIONS

- A. Provide all materials called for in these specifications and accompanying drawings and provide the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings, or shown on the drawings and not called for in the specifications must be provided.
- B. Where there is a discrepancy between drawings and specifications, the worst case shall be assumed.
- C. Drawings show arrangements of system desired and shall be followed as closely as practical. Because of the small scale of the drawings not all offsets and bends can be shown and these shall be provided as required, to fully complete the intent of plans. Should conditions and substitutions of equipment necessitate a rearrangement, prepare and submit for review scaled drawings of such rearrangement, before beginning work.
- D. Verify and check all measurements in the field.
- E. Review architectural, structural, and electrical plans, and cooperate and coordinate work with other trades to the extent that interference shall be avoided. Discrepancies shown on different plans, or between plans and specifications, shall promptly be brought to the attention of the Designer.

1.2 CONCEALMENT OF PIPE AND DUCTS

- A. Chases and Holes: Unless otherwise indicated, all piping and ductwork shall be run in concealed spaces between floor and ceilings or in chases. Ductwork and piping areas without ceilings shall be installed, exposed and as high as practical. This Contractor shall be responsible for the location and size of holes required for pipe, ducts and other equipment and shall advise of chase spaces and holes required as building progresses. Failure to do so shall require this Contractor to provide or cut same.

1.3 CUTTING & PATCHING

- A. This Contractor must have an experienced Mechanic upon the job before concrete floors, concrete or masonry walls are set in place, whose duty it shall be to locate the exact position of any and all sleeves and holes for the future installation of his pipe or duct work. This Contractor shall locate and size all openings required for his equipment in time to not delay the building construction.
- B. The Contractor is responsible to verify the location of any and all existing utilities in the vicinity of his work, including in wall cavities. The Contractor shall use appropriate methods including ground penetrating radar, x-ray, etc. to locate all existing utilities that may be in conflict with new wall openings. The Contractor shall provide adequate means of support and protection during wall cutting operations for utilities that are to remain in place.
- C. This Contractor shall arrange proper openings in the building to admit his equipment. If it becomes necessary to cut any portion of the building to admit any equipment or install mechanical systems, this Contractor shall be responsible for cutting and patching. The portions cut must be restored to their former condition by this Contractor.
- D. All cutting of structure shall be done using best method to minimize noise and cracking of structure. The method of cutting shall be approved by the Project Expediter (Prime Contractor) before work is started.

- E. All drilled holes required for equipment or supports shall be done by this Contractor. Holes for piping shall be core drilled only.

1.4 EQUIPMENT STANDS, FOUNDATIONS AND MISCELLANEOUS STEEL FOR HANGERS AND SUPPORTS

- A. Provide all equipment stands and supports for equipment as shown or required. Provide miscellaneous steel for hanging piping, ducts or other items of equipment as shown as required.
- B. All concrete foundations, curbs and pads for equipment, ductwork, piping, etc. shall be provided by this Contractor, unless otherwise indicated. Pads shall be provided for all floor standing equipment.
- C. All stands shall be adequately cross-braced to provide rigid supporting foundation. All stands shall be adequately anchored to wall or floor as required. All miscellaneous steel shall have one coat of shop paint and two finished coats of rust resistant paint.

1.5 SITE EXAMINATION

- A. Contractor, prior to submitting a bid, shall visit the site and thoroughly acquaint himself with the conditions under which the work will be performed.

1.6 PAINTING

A. WORK TO BE PAINTED:

- 1. All piping, ductwork, conduit, steel supports, hangers, and other mechanical items exposed to view in occupied areas shall be painted.
- 2. All insulated piping as noted in Section 230700, uninsulated piping, ductwork, supporting steel and hangers for piping, ductwork and equipment (except made of galvanized steel) shall be shop coated with rust proof primer and shall be field painted by Mechanical Contractor except where installed above ceilings or where concealed in building construction. Concealed supports and hangers do not require painting.
- 3. All exposed insulated and uninsulated piping and ductwork in Mechanical Room shall be painted by Mechanical Contractor with (2) coats of paint.
- 4. All areas where cutting and patching are required the mechanical contractor shall paint to match adjacent surfaces.

B. WORK NOT REQUIRING PAINTING:

- 1. Piping and ductwork above solid (lay-in, gypsum board, etc.) ceilings do not require painting.
- 2. All exposed items specified to be finished by the manufacturer will not be painted. See "Manufacturers' Finished Products".

C. MANUFACTURERS' FINISHED PRODUCTS:

- 1. All manufacturer finished products, such as water pumps, fans, air handling units, control panels, etc., shall have factory standard finish except where otherwise specified on the drawings or in other sections of this specification.
- 2. Contractor providing finished products shall be required to touch up any minor damages or scratches due to shipment, installation or exposure to weather on all equipment with baked enamel or equivalent finish, Prime coated equipment shall be cleaned and touched up. Large areas of damaged finish shall be painted to match factory painting.

PART 2 PRODUCTS

2.1 NOT APPLICABLE

PART 3 EXECUTION

3.1 FORMWORK

- A. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form side and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.
- B. Form Coating: Coat concrete-contact surfaces of forms to be removed. Apply form-coating compound before reinforcement is placed. Apply in accordance with manufacturer's instructions and remove excess compound and spillage.
- C. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.
- D. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
- E. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.
- F. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 degrees F, heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F, at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.

END OF SECTION

SECTION 23 03 00 – ELECTRICAL WORK FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 120V and 24V control Wiring
- B. Electrical wiring.
- C. Starters and controllers

1.2 CODES, STANDARDS, QUALIFICATIONS

- A. All work shall conform to all sections of the most current North Carolina State Building Codes
- B. All work shall conform to all North Carolina Department of Administration State Construction Office Guidelines.
- C. Electrical equipment shall be listed and/or labeled by an independent testing agency approved by the State Building Code.
- D. Enclosure for electrical equipment and enclosed switches shall meet NEMA standards.

PART 2 PRODUCTS

2.1 WIRING

- A. All wiring and conduit shall be in accordance with the requirements of Division 26. This includes wiring requirements from variable frequency drives to equipment motors (refer to VFD cable requirements in Division 26).
- B. Low voltage control wiring shall be not less than #18 gauge copper wire run in metallic conduit.
- C. Low voltage shall be defined as a circuit operating at less than 30 volts and meeting the requirements of NEC Section 720 for Class I, power limited circuits.

2.2 MOTORS

- A. Allowable manufacturers:
 - 1. Baldor Super-E EM/XE (general purpose family) with optional cast iron frame
 - 2. TECO/Westinghouse ASHH or Max-PE, WEG W22
 - 3. Toshiba
- B. Substitutions:
 - 1. Must be pre-approved in compliance with procedures outlined in 23 01 00 Mechanical General Specification.
- C. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ASA C50 and conform thereto for insulation resistance and dielectric strength. Motors shall be provided with conduit terminal box, adequate starting and protective equipment as specified or required. Size shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least shall be the horsepower indicated or specified. Motors shall be selected for quiet operation.
- D. Motors less than 3/4 HP shall be single phase, PSC/capacitor start-induction run, open type, splashproof. Motors 3/4 HP and larger shall be induction, open 3-phase multi tap unless otherwise indicated. Voltage for 3-phase motors is noted in schedules. Coordinate electrical service requirements with Electrical Contractor.

- E. Motors shall be provided with overload protection. On 3-phase motors overload protection shall be in the starters. Single-phase motors shall have built-in thermal overload protection.
- F. Motors shall be sufficient size for the duty to be performed, not less than that indicated on the drawings, and shall not exceed their full rated load when the driven equipment is operating at specified capacity under the most severe conditions likely to be encountered. All motors shall be for continuous duty classification based on 40 degrees C ambient temperature unless otherwise indicated.
- G. Motors less than 1 HP shall have efficiencies that comply with the current N.C. Building Code. Efficiency shall be determined in accordance with IEEE Standard 112, method B.
- H. Motors 1 HP and larger shall have efficiencies that comply with NEMA Premium Efficiency ratings.
- I. All vertically mounted motors shall be provided with thrust bearings.
- J. Motors shall be open dripproof (ODP) for indoor use where satisfactorily housed, guarded dripproof when exposed to contact by employees or building occupants, TEFC (totally enclosed fan cooled) for outdoor use.
- K. Motors that are specified to cycle on and off automatically under control of a device shall be capable of making starts as frequently as the device may demand. Other motors shall be capable of being started 4 times per hour without damage.
- L. Motors that are to be used with adjustable frequency drives shall be approved by the motor manufacturer for that service.
- M. All 3-phase motors shall be provided with lugs.
- N. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque. Class "B" insulation shall be provided.
 - 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 - 2. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 - 3. Service Factor: The service factor shall be at least 1.15 for polyphase motors and 1.35 for single phase motors.
 - 4. Provide solid shaft grounding rings (Aegis SGR or approved equal). Soft carbon brushes and split shaft grounding rings shall not be accepted.
- O. All motors 40 hp and larger not provided with VFD shall be provided with reduced voltage starters.
- P. For frames 284 or larger, bearing shall be capable of lubrication. Extend grease lines to an accessible location. For frames 140T-280T, bearings shall be capable of lubrication unless specifically reviewed and approved otherwise with Engineer and Owner.
- Q. The opposite shaft end bearing shall be clamped to secure the bearing in the housing. Electrical characteristics and horsepower shall be as specified on the project schedule.
- R. For air handler fan motors, in a direct drive application, motors shall be capable of running continuously from 0 to 120Hz and deliver full rated horsepower at 60 to 120Hz operating frequencies. All motors shall maintain a minimum service factor of 1.15 throughout a 60 to 120HZ operating range. Motors shall conform to a G2.0 balance per NEMA S2.19.

2.3 STARTERS AND CONTROLLERS

- A. Controllers and Control: Where controllers and controls are specified to be provided by the Contractor, they shall conform to the requirements specified below:
1. Controllers shall conform to adopted standards and recommended practices of the Industrial Control Standards of National Electrical Manufacturer's Association and the standard for Industrial Control Equipment of the Underwriters' Laboratories, Inc. Motors 93 W (1/8 hp) or larger and shall be provided with thermal overload protection. Manually reset type. Overload protective device shall be provided, mounted in separate enclosure. Single or double-pole tumbler heavy duty switches may be used as manual controllers for motors of 186 W (1/4 hp) or less in rating. Manual controllers for motors larger than 186 W (1/4 hp) shall be designed for purpose and shall have horsepower rating adequate for motor. Two speed motors shall have 2 winding type controllers unless otherwise specified.
 2. Combination magnetic starter shall be full voltage, across the line type with under-voltage release for manual or automatic operation and shall break all phases on 3 phase starters for motors up to 40 hp. Starters shall be provided with start-stop pushbuttons mounted on cover unless controlled by hand-off-automatic (HOA) device. Hand-off-automatic device shall not be wired to override safety device interlocks on starter and shall be mounted on the starter or if adjacent mounted remotely, provide test start pushbutton on starter. All auxiliary contacts required for interlocking purposes shall be furnished and installed by the Contractor furnishing the starter. All starters not included in motor control centers shall be provided by Division 23.
 3. Manual starters shall be provided with a manually operated trip free switch, horsepower rated with a separate fused disconnect.
 4. Contractor providing the starters shall be responsible for all motors to be protected with proper size heater or thermal elements. All starters and enclosures shall be NEMA Standard, Type 1 unless otherwise specified. In wet locations, enclosures shall be NEMA 3R.
 5. All starters and pushbutton stations shall be provided with labels as specified under identification designating service for which starter is used. Plate shall be firmly attached to starter or wall mounted adjacent to the starter.
 6. All cabinets provided for the installation of motor starters, control transformers, relays, and appurtenant items shall be provided with gravity or forced ventilation at the option of the manufacturer. Openings shall be placed at bottom and top of the cabinet or high-low in the door if recessed and of sufficient size to limit the temperature rise through the enclosure or ambient compensated heater elements shall be provided.
 7. All controllers and starters shall be rated for the same voltage as the motor which it serves. If the voltage is not indicated on the HVAC drawings, the Contractor shall provide the units at the voltage listed on the electrical drawings.
 8. Provide interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
 9. Provide built-in 120 volts control circuit transformer, fused from line side, where service voltage exceeds 240 volts.
 10. Provide externally operated manual reset.
 11. Motor connections shall be in waterproofed sealtite flexible conduit, maximum length of 457 mm (18"), except where plug-in electrical cords are specifically indicated.

2.4 SAFETY SWITCHES

- A. All safety switches specified in Division 23 or on mechanical plans shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated otherwise on plans. They shall be fused type unless specifically indicated otherwise on plans. Fused type shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and Individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others.
- B. Contractor shall furnish one spare set of fuses for each piece of equipment.
- C. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use raintight conduit hub fittings with bonding screw.
- D. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 EXECUTION

3.1 WIRING

- A. Regardless of voltage, furnish and install all temperature control wiring, and all interlock wiring and equipment control wiring for the equipment furnished.
- B. Electrical Contractor will furnish and install all power wiring to load side of starters (see details on plans). The mechanical contractor shall furnish disconnects for equipment. Mechanical contractor shall provide all line side power wiring (see details on plans) and temperature control and interlock wiring. Controllers and controls shall be provided by the Mechanical Contractor.
- C. Check with Electrical Contractor on service outlets provided to determine that service, circuit protection, switches and wiring provided are of adequate size to meet Code requirements for equipment provided. Discrepancies shall be brought to the attention of the Designer before work is installed. Cost for changes not so noted shall be at the expense of this Contractor. Electrical cost increase due to equipment substitution of different electrical characteristics shall be this Contractor's expense.
- D. Provide necessary electrical data for all equipment to the Electrical Contractor for proper coordination.
- E. Control and interlock wiring shall be run in conduit. Conduit shall be minimum 3/4" in size.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.
- G. Unless otherwise noted or specified, all low voltage and line voltage control and instrumentation wiring and devices for equipment furnished under Division 23 shall be provided as part of this Division 23. Control wiring is considered to be the portion of the wiring which carries the electric signal directing or indicating the performance of a starter, relay, or contactor generally installed between starters, indicators, and remote control devices. All wiring from indicated or available

electrical source in the electrical room and/or mechanical room to direct digital control panels shall be provided as part of this Division.

- H. Examine the drawings, and in cooperation with the Electrical Contractor, confirm the final location of all electrical equipment to be installed in the vicinity of piping. Plan and arrange all overhead piping to be no closer than 24" from the vertical line to electric motor controllers, switchboards, panelboards, or similar equipment. If the vertical line is less than 24", the installation of piping shall be relocated.

END OF SECTION

SECTION 23 05 00 – FIRESTOPPING AND WATERPROOFING

PART 1 GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. General

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all penetrations in connection with the installation of fire stopping and smoke stopping systems required to seal all penetrations of required rated partitions, walls or assemblies for Division 23 work.

B. Descriptions:

1. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
2. All penetrations through exterior walls, floors, and roof systems shall be sealed watertight.
3. Firestop all existing openings in walls, roofs, slabs and similar assemblies remaining as a result of removing existing pipes, ducts, conduit, equipment appurtenances.
4. Firestop and Smokestop as required for assembly type all new openings in walls, roofs, slabs and similar assemblies at pipe, duct, conduits, equipment and appurtenances.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 QUALITY ASSURANCE

A. Materials:

1. Materials shall be new, unused, properly stored and matching existing in colors, texture, finish, appearance and function.
2. Fire stopping and smoke stopping materials shall be delivered to the job site ready to install and require no critical mixing procedures or precise installation time constraints.
3. Materials shall be delivered to the site in sealed containers, fully identified with manufacturer's name, brand, type, grade and U.L. and FM labels. Store materials in a dry space under cover and off the ground.
4. Products shall be applied in strict accordance with their listing and manufacturers' application requirements.

B. Code and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:

1. ASTM E814, Fire Tests of Through-Penetration Firestop Systems.
2. UL 1479, Through-Penetration Firestop Systems.
3. UL 8418, Duct Fire Protection

C. Manufacturer: The following firestopping and waterproofing sealant manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M
4. Hilti
5. GE
6. Frye Putty

D. The following smoke stopping manufacturers are acceptable:

1. Nelson
2. Thomas & Betts
3. 3M

PART 2 PRODUCTS

2.1 FIRESTOPPING:

- A. Firestopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke and gases under conditions of installation and use when exposed to the ASTM E119 time-temperature rating of the assembly penetrated.
- B. All material shall be listed by U.L.

2.2 SMOKESTOPPING:

- A. Smoke-stop shall provide an effective barrier against the spread of smoke.
- B. All material shall be listed by U.L.

2.3 WATERPROOFING:

- A. Sealant materials shall be as follows:
 1. Penetrations of Fire Rated assemblies shall meet the requirements of 2.1 FIRESTOPPING specified hereinbefore.
 2. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

2.4 SUBMITTAL

- A. Provide U.L. approval assembly detail for specific application of the product.
- B. Provide installation detail of the product

PART 3 EXECUTION

3.1 GENERAL

- A. Exercise care in the performance of this contract so as not to damage any existing building components and finishes, outside components, shrubs, or other appurtenances.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant.

- C. Openings larger than required for proper installation of pipe or duct shall be patched or repaired.
- D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.
- E. Firestopping and smoke stopping will meet the U.L. approved assembly detail for the product used.

3.2 EQUIPMENT PENETRATIONS:

- A. Seal all openings into equipment resulting from installation of equipment such as piping and conduit.
- B. Repair all insulation damaged during installation of equipment.

END OF SECTION

SECTION 23 05 10 – GAUGES AND METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pressure gauges and Pressure Gauge taps.
- B. Thermometers and thermometer wells.

1.2 ENVIRONMENTAL REQUIREMENTS

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

PART 2 PART 2 PRODUCTS

2.1 PRESSURE GAUGES

- A. Glycerin-Filled Pressure Gauge: 4-1/2" dial with snubber and stainless steel or cast aluminum case, gasketed Plexiglas Lens, stainless steel movement, Polypropylene blow-out back plate, White scale with black divisions and numerals, Plastic lens, Manufactured in accordance with ASME specification B40.1, Grade 2A.
- B. Acceptable Manufacturers:
 - 1. Dwyer
 - 2. Weiss
 - 3. Weksler
 - 4. Trerice
- C. All gauges shall have brass valve. Graduation in feet.

2.2 PRESSURE GAUGE TAPPINGS

- A. Gauge Valve: Brass 1/4" ball valve.
- B. 1/4 inch NPT for minimum 150 psig,

2.3 STEM TYPE THERMOMETERS

- A. Acceptable manufacturers
 - 1. Trerice
 - 2. Weksler
 - 3. Weiss
 - 4. Dwyer
- B. Thermometer: ASTM E1, adjustable angle, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device. Temperature ranges shall be appropriate for water service type and shall be submitted to Engineer for approval prior to installation.
 - 1. Solar powered
 - 2. 1/2" digit display
 - 3. Field selectable units
 - 4. Display rated for minimum of 10 lux lighting levels.

5. Range: -50 to 300°F
6. Resolution: 0.1° between -19.9 to 199.9°F (-28 to 93°C).
7. Display: 3 digit LCD
8. Response time: 10 seconds
9. Sensor: Glass passivated thermistor

2.4 THERMOMETER SUPPORTS

- A. Pipe Socket: Brass separable sockets with insulation extensions as required.

2.5 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide one pressure Gauge per pump, installing taps on suction and discharge of pump. Pipe to Gauge. Provide pressure Gauge at inlet, outlet connection to condenser and evaporator of chiller, coils.
- C. Install pressure gauges with pulsation dampers. Provide valves to isolate each Gauge. Extend nipples to allow clearance from insulation.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation. Dip thermometer stems in heat conducting paste before installing in wells. Provide thermometers at each inlet, outlet of coils, condenser and evaporator connections to each chiller, boiler.
- E. Install thermometer sockets adjacent to controls systems transmitter.
- F. Provide instruments with scale ranges selected according to service.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level.
- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- I. Locate test plugs adjacent thermometers and thermometer sockets adjacent to pressure gauges and pressure Gauge taps adjacent to control device sockets.

END OF SECTION

SECTION 23 05 13 – VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Adjustable frequency drive units for pumps and fans.

1.2 QUALITY ASSURANCE

- A. The complete unit shall be listed by a testing agency approved in North Carolina.
- B. All wiring to conform to the NEMA Standards.
- C. All enclosures to be NEMA rated.
- D. All units shall conform to Part 23 of the FCC regulations on RFI/EMI emissions.
- E. The inverter and any associated hardware are to be "run in" at rated ambient temperature and rated load on variable speeds at the manufacturer's plant prior to shipment.
- F. The VFD and options shall be tested to ANSI/UL Standard 508. The complete VFD including all specified options, shall be assembled by the manufacturer, which shall be UL-508 certified for the building and assembly of option panels. Local representative panel shop assembly for option control panels is not acceptable. The appropriate UL stickers shall be applied to both the drive and option panel. Both drive and option panel shall be manufactured in ISO 9001 certified facilities.
- G. All adjustable frequency drives for mechanical equipment shall be furnished by the same manufacturer.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Square D
- B. ABB
- C. Alan Bradley
- D. Cutler Hammer
- E. Danfoss Graham

2.2 EQUIPMENT REQUIREMENTS

- A. The seller shall, with the aid of the buyer's electrical power single line diagram, perform an analysis to initially demonstrate that the supplied equipment will meet the IEEE standards after installation. If, as results of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, the cost of such equipment shall be included in the bid.
- B. A harmonic analysis shall be submitted with the approval drawings to verify compliance with IEEE-519 1992 voltage and current distortion limits as shown in Tables 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or metering point.

Table 10.2 Low-Voltage System Classification and Distribution Limits		
	Special Applications (1)	General Systems (2)
Notch Depth	10%	20%
THD (Voltage)	3%	5%

NOTE: 1) Airports and medical facilities having patient monitoring equipment.
2) In volt-microseconds at rated voltage and current.

Table 10.3 Current Distortion Limits for General Distribution Systems (120V Through 69,000V)						
Maximum Harmonic Current Distortion in Percent of IL						
	Individual Harmonic Order (Odd Harmonics)					
Iso/IL	<11	$11 \leq sn < 17$	$17 \leq sn < 23$	$23 \leq sn < 35$	$35 < sn$	TDD
<20 (1)	4.0	2.0	1.5	0.6	0.3	5.0
20<50	7.0	3.5	2.5	1.0	0.5	8.0
50<100	10.0	4.5	4.0	1.5	0.7	12.0
100<1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Notes:

- 1) Even harmonics are limited to 25% of the odd harmonic limits above.
 - 2) Current distortion that results in a dc offset, e.g. half-wave converters, are not allowed.
 - 3) All power generation equipment is limited to these values of current distortion, regardless of actual Iso/IL
- C. The VFD shall convert incoming fixed frequency three-phase AC power into variable frequency and voltage for controlling the speed of three phase AC motors (note: all motors provided for VFD equipment shall be inverter duty rated). The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control. An advanced sine wave approximation and voltage vector control shall be used to allow operation at rated motor shaft output at nominal speed with no derating. This voltage vector control shall minimize harmonics to the motor to increase motor efficiency and life. The VFD shall include a full-wave diode bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load. The VFD, including the options listed below, shall be tested to ANSI/UL Standard 508.
1. The VFD shall have a DC link reactors on both positive and negative rails of the DC bus to minimize power line harmonics. VFD's without a DC link reactor shall have a 5% impedance input AC line reactor.
 2. An automatic energy optimization selection feature shall be provided standard in the drive. This feature shall reduce voltages when lightly loaded and provide a 3% to 10% additional energy savings.
 3. Galvanic and/or optical isolation shall be provided between the drive's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. Drives not including isolation on both analog I/O and discrete I/O shall include additional isolation modules.
 4. Drive shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
 5. Input and output power circuit switching can be done without interlocks or damage to the VFD.
 6. Class 20 I2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications.
 7. Protection against input transients, loss of AC line phase, short circuit, ground fault, overvoltage, undervoltage, drive overtemperature and motor overtemperature.
 8. Display all faults in English language. Codes are not acceptable.
 9. If the temperature of the drive's heat sink rises to 80o C, the drive shall automatically reduce the carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the drive shall automatically reduce its output frequency to the motor. As the drive's heat sink temperature returns to normal, the drive shall automatically increase the output frequency to the motor and return the carrier frequency to it's normal switching speed.
 10. Fully range minimum and maximum speed adjustment with ability to automatically
 11. Select speeds as defined in controls sequence.
 12. Separately adjustable linear acceleration and deceleration.

13. Field adjustable or automatic current limit.
14. Four short circuit current settings protection.
15. All units shall operate on a 4-20 ma signal in automatic mode.
16. Drive shall communicate with building automation system via BACnet protocol.
17. Be rated to provide 100% of rated current, minimum 110% break away current.
18. Inverter is to be rated for an input line voltage variation of + 10% and -10%.
19. Provide a manual 3 contactor bypass consisting of a door interlocked main fused disconnect padlockable in the off position, a built-in motor starter and a four position DRIVE/OFF/LINE/TEST switch controlling three contactors. In the DRIVE position, the motor is operated at an adjustable speed from the drive. in the OFF position, the motor and drive are disconnected. In the LINE position, the motor is operated at full speed from the AC power line and power is disconnected from the drive, so that service can be performed. In the TEST position, the motor is operated at full speed from the AC line power. This allows the drive to be given an operational test while continuing to run the motor at full speed in bypass. Customer supplied normally closed dry contact shall be interlocked with the drives safety trip circuitry to stop the motor whether in DRIVE or BYPASS mode in case of an external safety fault. The use of microprocessor based bypass control shall not be allowed.
20. Provide circuit breaker for main power disconnect. Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.
21. The drive and bypass circuits shall operate independently of each other, and have completely separate switch mode power supplies operating off AC line Voltage.
22. The bypass shall provide motor functionality with the drive removed. The bypass shall automatically respond to the BAS for start and stop while operating in bypass.
23. The bypass shall include a service switch or line isolation contactor to disconnect power to the drive, but not the bypass.
24. The drive and bypass package shall be UL listed and have a labeled, short circuit current rating (SCCR) of 100,000 amps.
25. Smoke purge circuitry shall be interconnected such that an external dry contact can be used in both drive and bypass modes.

PART 3 EXECUTION

3.1 INSTALLATION AND STARTUP

- A. Install in accordance with manufacturer's written installation instructions.
- B. The contractor shall assume the responsibility for coordinating the purchased equipment with the motor served and with the automatic temperature control system, paying specific attention to the signal sent and received, the ground source and the required speed range.
- C. Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. All power and control wiring shall (including from VFD to motor) be installed in conduit. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

- D. VFD shall be installed a maximum distance of 100' away from associated motor.
- E. The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.
- F. The manufacturer shall provide start-up commissioning of the variable frequency drive and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for VFD field repair are not acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Start-up shall include customer operator training at the time of the equipment commissioning.

3.2 WARRANTY

- A. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service.

END OF SECTION

SECTION 23 05 29 – SUPPORT AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment and pipe stacks.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Placement of inserts sleeves in existing walls and slabs.
- B. Placement of roofing duct supports.
- C. Placement of equipment roof supports.
- D. Placement of roof sleeves, vents, and curbs.

1.3 REFERENCES

- A. ASME B31.1 - Power Piping
- B. ASME B31.2 - Fuel Gas Piping
- C. ASME B31.5 - Refrigeration Piping
- D. ASME B31.9 - Building Services Piping
- E. ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- F. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- G. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- H. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Installation of Standpipe and Hose Systems
- K. UL 203 - Pipe Hanger Equipment for Fire Protection Service

1.4 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Product Data: Provide manufacturers catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for support of hydronic piping.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers for insulated piping shall be sized to fit around the pipe covering. Contractor shall provide at each hanger a galvanized insulation protection shield formed to fit the outside of the

covering. Shield shall extend above center line on both sides. Shield to be #18 gauge up to 3" pipe, #16 gauge up to 6" pipe and #14 gauge for 8" and larger. Provide rigid insulation under all hanger. See Section 230700, Insulation.

B. Hydronic Piping:

1. Conform to MSS SP58.
2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches (76 mm): Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
1. Waterproofing: 5 lb/sq ft (24.5 kg/sq m) sheet lead
 2. Soundproofing: 1 lb/sq ft (5 kg/sq m) sheet lead.
- D. Flexible Flashing: 47mil thick sheet compatible with roofing.
- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.4 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm thick) galvanized steel or schedule 10 PVC.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Sleeves for Round Ductwork: Galvanized steel.
- E. Sleeves for Rectangular Ductwork: Galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 INSERTS

- A. Provide inserts for placement in concrete walls and slabs as noted on plans.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3.3 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- C. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- D. Use hangers with 1 1/2 inch (38 mm) minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Prime coat exposed steel hangers and supports. Refer to Division 9. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 6 inches thick and extending 6 inches (150 mm) beyond supported equipment.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked one inch (25 mm) minimum into hub, 8 inches (200 mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash, and seal.
- C. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- D. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping material and calk as per UL approved detail. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

	Pipe Size Inches	Max Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)
1.	1/2 to 1-1/4	6.5 (2)	3/8 (9)
2.	1-1/2 to 2	10 (3)	3/8 (9)
3.	2-1/2 to 3	10 (3)	1/2 (13)
4.	4 to 6	10 (3)	5/8 (15)
5.	8 to 12	12 (3.7)	7/8 (22)

END OF SECTION

SECTION 23 05 48 – VIBRATION ISOLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation as noted on plans for motor driven equipment over 3/4 HP, plus connected piping and ductwork. Provide neoprene pad isolator under each Air Handling Unit.
- B. Provide minimum static deflection of isolators for equipment as indicated.
 - 1. Basement, Under 20 hp (15 kw)
 - a) Under 400 rpm: 1 inch (25 mm)
 - b) 400 - 600 rpm: 1 inch (25 mm)
 - c) 600 - 800 rpm: 0.5 inch (12 mm)
 - d) 800 - 900 rpm: 0.2 inch (5 mm)
 - e) 1100 - 1500 rpm: 0.14 inch (4 mm)
 - f) Over 1500 rpm: 0.1 inch (3 mm)

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators:
 - 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Spring Mounts: Provide with levelling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.

4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
5. Restraint: Provide heavy mounting frame and limit stops.
- C. Closed Spring Isolators:
 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
 2. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
- D. Spring Hanger:
 1. Spring Isolators:
 - a) For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b) Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Housings: Incorporate either neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.
 4. Capable of 20 degree hanger rod misalignment.
- E. Neoprene Pad Isolators:
 1. Rubber or neoprene waffle pads.
 - a) 30 durometer.
 - b) Minimum 1/2 inch thick.
 - c) Maximum loading 40 psi.
 - d) Height of ribs shall not exceed 0.7 times width.
 2. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- F. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install isolation for motor driven equipment.
- C. Adjust equipment level.

- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- G. Provide pairs of horizontal limit springs on hanger supported, horizontally mounted fans.
- H. Support piping connections to isolated equipment as follows:
 - 1. Up to 4 Inch (100 mm) Diameter: First three points of support.
 - 2. 5 to 8 Inch (125 to 200 mm) Diameter: First four points of support.
 - 3. 10 inch (250 mm) Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch (25 mm) static deflection or 1/2 static deflection of isolated equipment.
- I. Connect wiring to isolated equipment with flexible hanging loop.

END OF SECTION

SECTION 23 05 53 – MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Ceiling Tacks.

1.2 REFERENCES

- A. ASME A13.1 Scheme for the Identification of Piping Systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1 1/2 inch diameter.
- B. Chart: Typewritten letter size list in 3-ring notebook.

2.3 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1 1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1 1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2 1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1 1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2 1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3 1/2 inch high letters.
 - 6. Ductwork and Equipment: 2 1/2 inch high letters.
- B. Stencil Paint: Semi gloss enamel, black on white background conforming to ASME A13.1.

2.4 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head; In addition, provide clear plastic label adjacent to ceiling tack indicating specific equipment identification tag
- B. Color code as follows:
 - 1. Yellow - HVAC equipment
 - 2. Red - Fire dampers/smoke dampers
 - 3. Green - Plumbing valves

4. Blue - Heating/cooling valves

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

- A. All equipment requiring periodic maintenance or testing located in concealed spaces shall be clearly identified on an adjacent finished surface to identify the location of equipment. For equipment mounted above ceilings, provide an ID label on the ceiling below the equipment. Typical concealed equipment includes air terminals, air valves, PRVs, mixing valves, duct and pipe differential pressure sensors, steam traps, fire smoke dampers, etc. Labels shall be clear or white with 0.375" high black letters.
- B. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- C. Install tags with corrosion resistant chain.
- D. Apply stencil painting, Black on white background or color as coordinated with Engineer and Owner prior to beginning work.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify thermostats relating to terminal boxes or valves with nameplates.
- I. Identify valves in main and branch piping with tags.
- J. Identify air terminal units and associated valves with numbered tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with stencils. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic and steam systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 ALLOWANCES

- A. Work is included in this section and is part of the Contract Sum/Price.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- E. SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual locations of flow and pressure measuring stations and balancing valves.

1.5 QUALIFICATIONS

- A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience certified by AABC.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, or registered Professional Engineer experienced in performance of this Work and licensed in the State of North Carolina.

1.6 PRE BALANCING CONFERENCE

- A. Convene one month prior to commencing work. Include all pertinent contractors and designers.

1.7 SEQUENCING

- A. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.
- B. The test and balance report shall be completed, reviewed, and approved by project engineer prior to final inspection and occupancy. Preliminary/rough draft reports are not acceptable.

1.8 SCHEDULING

- A. Schedule and provide assistance in final adjustment and test of life safety systems.

PART 2 PRODUCTS

This Part Not Used

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted.
- C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make technician and instruments available to Designer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for air conditioning systems and plus or minus 5 percent of design for exhaust systems.
- B. Hydronic Systems: Adjust to within plus or minus 10 percent of design.
- C. Where pressure relationship between adjacent spaces is called for, document compliance.

3.4 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures control.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct mounted devices.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Provide summary report with all test and equipment data included.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust automatic, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building and/or system static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximate positive static pressure called for.
- M. Check all motorized dampers for leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on suitable temperature difference.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.

- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

- 1. Pumps
- 2. Air Coils
- 3. Air Handling System
- 4. Fans
- 5. Air Filters

B. Report Forms

- 1. Title Page:
 - a) Name of Testing, Adjusting, and Balancing Agency
 - b) Address of Testing, Adjusting, and Balancing Agency
 - c) Telephone number of Testing, Adjusting, and Balancing Agency
 - d) Project name
 - e) Project location
 - f) Project Architect
 - g) Project Engineer
 - h) Project Contractor
 - i) Project altitude
 - j) Report date
- 2. Summary Comments:
 - a) Design versus final performance
 - b) Notable characteristics of system
 - c) Description of systems operation sequence
 - d) Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e) Nomenclature used throughout report
 - f) Test conditions
- 3. Instrument List:
 - a) Instrument
 - b) Manufacturer
 - c) Model number
 - d) Serial number

- e) Range
- f) Calibration date
- 4. Electric Motors:
 - a) Manufacturer
 - b) Model/Frame
 - c) HP/BHP
 - d) Phase, voltage, amperage; nameplate, actual, no load
 - e) RPM
 - f) Service factor
 - g) Starter size, rating, heater elements
 - h) Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a) Identification/location
 - b) Required driven RPM
 - c) Driven sheave, diameter and RPM
 - d) Belt, size and quantity
 - e) Motor sheave diameter and RPM
 - f) Center to center distance, maximum, minimum, and actual
- 6. Pump Data:
 - a) Identification/number
 - b) Manufacturer
 - c) Size/model
 - d) Impeller
 - e) Service
 - f) Design flow rate, pressure drop, BHP
 - g) Actual flow rate, pressure drop, BHP
 - h) Discharge pressure
 - i) Suction pressure
 - j) Total operating head pressure
 - k) Shut off, discharge and suction pressures
 - l) Shut off, total head pressure
- 7. Cooling Coil Data:
 - a) Identification/number
 - b) Location

- c) Service
 - d) Manufacturer
 - e) Air flow, design and actual
 - f) Entering air DB temperature, design and actual
 - g) Entering air WB temperature, design and actual
 - h) Leaving air DB temperature, design and actual
 - i) Leaving air WB temperature, design and actual
 - j) Water flow, design and actual
 - k) Water pressure drop, design and actual
 - l) Entering water temperature, design and actual
 - m) Leaving water temperature, design and actual
 - n) Saturated suction temperature, design and actual
 - o) Air pressure drop, design and actual
8. Heating Coil Data:
- a) Identification/number
 - b) Location
 - c) Service
 - d) Manufacturer
 - e) Air flow, design and actual
 - f) Water flow, design and actual
 - g) Water pressure drop, design and actual
 - h) Entering water temperature, design and actual
 - i) Leaving water temperature, design and actual
 - j) Entering air temperature, design and actual
 - k) Leaving air temperature, design and actual
 - l) Air pressure drop, design and actual
9. Air Moving Equipment
- a) Location
 - b) Manufacturer
 - c) Model number
 - d) Serial number
 - e) Arrangement/Class/Discharge
 - f) Air flow, specified and actual
 - g) Return air flow, specified and actual

- h) Outside air flow, specified and actual
 - i) Total static pressure (total external), specified and actual
 - j) Inlet pressure
 - k) Discharge pressure
 - l) Sheave Make/Size/Bore
 - m) Number of Belts/Make/Size
 - n) Fan RPM
10. Outside Air Data:
- a) Identification/location
 - b) Design air flow
 - c) Actual air flow
 - d) Design return air flow
 - e) Actual return air flow
 - f) Design outside air flow
 - g) Actual outside air flow
 - h) Return air temperature
 - i) Outside air temperature
 - j) Required mixed air temperature
 - k) Actual mixed air temperature
 - l) Design outside/return air ratio
 - m) Actual outside/return air ratio
11. Duct Traverse:
- a) System zone/branch
 - b) Duct size
 - c) Area
 - d) Design velocity
 - e) Design air flow
 - f) Test velocity
 - g) Test air flow
 - h) Duct static pressure
 - i) Air temperature
 - j) Air correction factor

END OF SECTION

SECTION 23 07 00 – INSULATION

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work required under this section consists of insulation for piping and duct system and equipment specified in Division 23.
- B. Provide all necessary labor, materials, tools and equipment to perform work required on the drawings and specified herein.
- C. All pipe fittings, valves, and strainers to be insulated.
- D. Certain equipment and/or systems to be factory insulated by manufacturer. Factory insulation materials to be as specified in applicable sections of the specifications.

1.2 DEFINITIONS

- A. Thermal resistance “R” values are expressed in units of “Hour-Degrees F-sq. ft./Btu per inch of Thickness” on a flat surface at a mean temperature of 75 degrees F unless noted otherwise.
- B. Thermal conductivity (K), the reciprocal of "R", btu per inch thickness/hr/ft²/degree.
- C. Insulation to consist of insulating material, jacket, mastic, and adhesive, either as a “system” or as an individual component when used separately.

1.3 QUALITY ASSURANCE / CERTIFICATION

- A. Unless noted otherwise, all insulation, adhesives, coatings, sealers, and tapes to have a flamespread rating of 25 or less and smoke development of 50 or less when tested in accordance with ASTM E-84, NFPA 225 AND UL 723.
- B. Apply insulation in a workmanlike manner using experienced, qualified tradesmen.
- C. Do not apply insulation until all pressure testing has been completed, inspected and released or insulation application.
- D. Clean and dry surfaces prior to insulation application.
- E. Butt insulation joints firmly together; smoothly and securely install all jackets and tapes.
- F. Insulation jacket for duct, pipe, and equipment exposed to weather to be certified as self-extinguishing in less than 53 seconds when tested in accordance with ASTM D1692.
- G. Certify that all duct and piping insulation meets the minimum requirements of the current State Energy Code for New Building Construction.

PART 2 PRODUCTS

2.1 MATERIALS FOR PIPE AND EQUIPMENT

- A. Provide factory premolded or shop mitered segment type insulation for pipe, fittings, and valves, unless otherwise noted.
- B. Fitting insulation to be of same thickness and material as adjoining pipe insulation.

C. Cellular Glass (Foamglass)

1. Product to be guaranteed by manufacturer to have continuous operational temperature limit of not less than 90 degrees F and minimum "R" value of 2.63.
2. Provide Pittsburgh Corning "Foamglass" noncombustible factory-molded material.
3. Provide factory applied pre-sized glass cloth jacket having an inside vapor barrier and white exterior color equivalent to Johns-Manville "Flame-Safe type "GVB".
4. Provide for the following services:
 - a) Under pipe saddles where compressible piping insulation is used (Fiberglass, flexible elastomeric).
 - b) At all penetrations of rated walls and floors with insulated piping services.

D. Flexible Elastomeric

1. Provide AP Armaflex manufactured by Armstrong or equivalent.
2. Provide 2-pound density, fire-retardant polyolefin, flexible type insulation, pre-formed tubular for piping and sheet for equipment.
3. Maximum water vapor transmission rate of 0.03 perms per inch and UV stabilized with a guaranteed outdoor life of 10 years.
4. Product to have continuous operational temperature limit of not less than 210 degrees F and a minimum "R" value of 3.71.
5. Provide white, self-seal Armaflex 2000 manufactured by Armstrong for 1/2 inch application thickness.
6. Provide insulation for the following services:
 - a) Copper or steel moisture condensate drains: 1/2-inch thick.

E. Glass Fiber

1. Provide factory-formed, factory-jacketed "system" type fiberglass insulation.
2. Jacket to be fiberglass reinforced, white kraft paper with aluminum foil vapor barrier.
3. Insulation density to be not less than 3.5 pounds per cubic foot.
4. Product to have continuous operational temperature limit of no less than 650 degrees F and a minimum "R" value of 4.00.
5. Product to be equivalent to Manville "Micro-Lok 650" with Type AP jacketing. Applicable products manufactured by Certainteed, Knauf, Owens Corning or Blue Trymer 2000 are acceptable
6. Provide insulation for following services:
 - a) Heating hot water
 - (i) 1-1/2 inch diameter and smaller: 1-1/2" thick.

(ii) Above 1-1/2 inch diameter: 2" thick.

F. Rigid Foam Insulation

1. Insulation shall be polyisocyanurate foam or Styrafoam with a K value (90 days aged) of 0.20 at a mean temperature of 75 degrees F. Density shall be 2#/cu. ft., flame spread less than 30 and smoke density less than 150 in 4" thickness. Insulation shall not be used in plenums. All joints and seams shall be neatly sealed in place with Foster 95-50 vapor barrier adhesive.
2. Valves and fittings shall be insulated with same material and to the same thickness as adjoining pipe. When insulating flanges and valve bodies, insulation shall extend a minimum of 1" beyond the end of the flange bolts and the bolt area shall be filled with fiberglass before molded insulation is applied.
3. Fill small voids with approved sealer before finish is applied.
4. Provide a one-piece Zeston type fitting jacket as recommended by the manufacturer for the applicable design conditions.
5. Clean and apply bitumen coating prior to applying rigid foam insulation.
6. Apply on:
 - a) Chilled Water piping: 1-1/2" thick.
 - b) Chilled water specialties, except those insulated with flexible foam: 1-1/2" thick.

2.2 MATERIALS FOR DUCTS

A. Blanket Type Insulation

1. Provide minimum 1 pound per cubic foot density, flexible, factory reinforced glass fiber blanket with foil-faced, glass-fiber reinforced kraft vapor barrier jacket. Provide 1.5 pcf with vinyl jacket where noted.
2. Insulation to have a minimum installed "R" value as follows:
 - a) Unconditioned spaces (mechanical rooms) = R-6
 - b) Outdoors (roof, etc.) = R-8
 - c) All else = R-5
3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens-Corning.
4. Provide glass fiber blanket insulation for the following:
 - a) Unlined hot air or cold air supply ducts concealed from view (except where noted otherwise): 2 inch thick.

B. Glass fiber Board Type Insulation

1. Provide minimum 3 pound per cubic foot density semi-rigid insulation with factory applied reinforced foil faced kraft vapor barrier glass fiber board "system" type insulation.
2. Insulation to have a minimum installed "R" value as follows:

- a) Unconditioned spaces (mechanical rooms) = R-6
 - b) Outdoors (roof, etc.) = R-8
 - c) All else = R-5
3. Product to be manufactured by Manville, or equivalent by Certainteed, Knoff, or Owens Corning.
4. Provide glass fiber board insulation for the following:
- a) Ducts within equipment rooms and exposed to view: 1-1/2 inch thick.
 - b) Ductwork located outside of building or outside of building insulation system: 2-inch thick
 - c) Unlined apparatus casing: 1-1/2 inch thick.
- C. Exhaust ductwork shall not be insulated.

2.3 MATERIALS FOR FITTING AND VALVES

- A. Premolded or mitered and fitted insulation and one-piece PVC insulated fitting covers.
- B. Provide factory pre-molded one-piece PVC insulated fitting covers, precut insulation inserts and installation materials for the following services:
- 1. All pipe fittings and valves.
 - 2. All grooved coupling installations.
- C. Materials to be equal to Foster Seaglass PVC fitting cover, UNI-Fit inserts and accessories, or equivalent by Molded Acoustical Products, Inc., Hamfab, Zeston division of Mansfield; or Armstrong Products.

2.4 COATINGS, FINISHES AND JACKETS

- A. Piping and Equipment:
- 1. Prior to application of all pipe insulation, pipe surfaces shall be cleaned of rust and debris and painted. Prior to starting painting, Engineer and/or CM shall approve pipe when cleaned and painted.
 - 2. All chill water piping and all piping in Mechanical Rooms shall be painted with one coat of rust proof paint after cleaning and prior to application of insulation. Paint on hot water, steam and condensate piping shall be high temperature.
 - 3. For pipe, fittings and valves through 1-1/2-inch size in systems exposed-to-view inside building or in equipment rooms, finish to be PVC factory jacket.
 - 4. For tanks, heat exchangers, insulated equipment and pipes 2" and larger in systems exposed inside building or in equipment rooms, cover insulation with one layer of 8 oz. canvas and finish with fire retardant logging adhesive ready for painting.
 - 5. Fitting Jackets: Inside use PVC molded one-piece or matching 2-piece jacket.
 - a) Hot surfaces; apply with stainless steel tacks or staples.

- b) Cold surface; use 2" wide, 10 mil vinyl tape furnished by manufacturer of jacket. Where vapor barrier is required, apply tape to jacket and vapor barrier on pipe before canvas is applied.
- 6. For any service when above grade and exposed to the weather outside building, cover pipe insulation with 0.016-inch thick aluminum jacket.
- 7. Do not insulate valves in systems operating above 60 degrees F. Paint valves with a rust-resistant product equivalent to Rustoleum.
- 8. For flexible tubular elastomeric pipe and fitting insulation when exposed-to-view inside building or exposed to the weather, finish with two coats of fire retardant self-extinguishing vinyl lacquer type flexible coating equivalent to Armstrong "Armaflex Finish".

B. Ducts

- 1. In Equipment Rooms and where exposed to view: 8 oz canvas treated with fire retardant lagging adhesive. Seal joints and seams with 3" aluminum tape. Reinforce corners.

PART 3 EXECUTION

3.1 GENERAL

- A. All surfaces to be clean and dry (and painted where noted above) when covering is applied. Covering to be dry when installed and during application of any finish.
- B. All adhesives, cements and mastics to be compatible with materials applied without attacking materials in either wet or dry state.
- C. Insulation Exposed to view to have a well tailored appearance.
- D. Do not insulate expansion tanks or heads of hot water pumps.
- E. Install all insulation in accordance with manufacturer's instructions.

3.2 PENETRATION OF RATED WALLS, PARTITIONS & FLOORS

- A. Do not pass pipe insulation through fire rated partitions or floors unless firestopping system is listed for insulated pipe. Stop and properly terminate insulation at each side of partition.
- B. Install foamglass insulation on chilled water piping where lines pass through rated partitions.
- C. Stop all duct coverings including jacket and insulation at all penetrations of rated walls. Flare-out or extend insulation jacket at least 2-inches beyond angle frames of fire dampers and seal to structure.
- D. Maintain vapor barrier.
- E. Install covering over damper and smoke detector access doors readily removable and identifiable.

3.3 INSTALLATION OF DUCT INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Insulated ductwork conveying air below ambient temperature:

1. Provide insulation with vapor barrier jacket.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- C. Insulated ductwork conveying air above ambient temperature:
1. Provide with or without standard vapor barrier jacket.
 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- D. Blanket type insulation
1. Apply jacketed blanket type glass fiber pulled snug to ducts but not more than 1/2-inch compression at corners.
 2. Use insulation having 2-inch tab, or cut insulation long enough to allow for "peel-off" of insulation from jacket to effect a minimum overlap tab of 2-inch.
 3. Staple lap with flare type staples on 1-inch centers.
 4. Cover standing seams, stiffeners, and braces with an insulation blanket, using 2-inch jacket lap and staple lap.
 5. Cover and seal all staples and attachment pins with foster 30-35 reinforced with glass cloth or FSK tape.
 6. Apply insulation with approved adhesive and weld pins at 18" o.c. on the bottom of ducts 16" or wider. Provide pins at 18" o.c. on sides of ducts 20" or more. Vertical ducts that are larger than 16" shall have weld pins on all sides. Overlap facing 3" and seal with approved adhesive or apply reinforced aluminum tape. Seal punctures and breaks with aluminum tape.
- E. Jacketed Board Type Insulation:
1. Apply jacketed board type insulation to ducts using adhesive and weld pins or nylon "Stick-clip" plates having self-locking, coated metal or nylon discs.
 2. If insulation is grooved for corners, pin as required to hold insulation tight to duct.
 3. Seal pins and joints with Foster 30-56 reinforced with glass cloth or FSK tape.
 4. Insulation shall be applied to the ductwork using approved adhesive and mechanical fasteners such as weld pins or stick clips located not less than 3" from each edge or corner of the board. Pin spacing along the duct not greater than 12" o.c. Additional fasteners used on the sides and bottom of all ducts at a maximum spacing of approximately 18" o.c. All edges and joints sealed with 5" wide aluminum vapor barrier tape applied with Foster 85-20 adhesive. All punctures in the vapor barrier facing likewise sealed
 5. Cover all joints, rips, tears, punctures, disc heads, staples, or breaks in vapor barrier jacket with 4-inch wide woven glass fabric tape embedded in equivalent of Childers CP-82 or

Benjamin-Foster No. 85-20 "Sparkfast" vapor barrier fire resistant adhesive. Pressure sensitive tape permitted if recommended by manufacturer.

6. Cover all board type insulation with 8 oz. canvas jacket applied with fire retardant logging adhesive.

F. Rigid Foam Insulation

1. Apply with adhesive as recommended and weld pins or "Stock-clips" having self locking metal or nylon discs.
2. Place pins 3" from edges and not more than 18" O.C.
3. Seal all joints and pin penetrations with 3" wide aluminum tape or as recommended by the manufacturer.
4. Finish insulation with 2 coats of Armaflex white paint.

3.4 INSTALLATION OF PIPE INSULATION

- A. Install in accordance with TIMA National Insulation Standards.
- B. Exposed Piping: Cover insulation with 8 oz canvas or factory jacket as noted above. Locate seams in least visible locations. Size canvas for painting. Paint (color as noted herein or as required by owner) canvas and PVC fitting covers.
- C. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Glass fiber insulated pipes conveying fluids below ambient temperature:
 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe and PVC fitting covers.
- E. Glass fiber insulated pipes conveying fluids above ambient temperature:
 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Insulation above furred ceiling and in chases requires no finish beyond factory jacket.
- G. Inserts and Shields:
 1. Shields: Galvanized steel between pipe hangers or hanger rolls and insulation.
 2. Insert location: Between support shield and piping and under the finish jacket.

3. Insert configuration: Minimum 12" inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 4. Insert material: Hydrous calcium silicate or foamglas insulation material suitable for the planned temperature range.
- H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire and smoke separations, refer to Section 230500.

3.5 INSTALLATION OF EQUIPMENT COVERING

- A. Factory Insulated Equipment: Do not insulate, except as otherwise noted.
- B. Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands as appropriate.
- C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- E. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- F. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- G. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- H. Finish insulation at supports, protrusions, and interruptions.
- I. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- J. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed for inspection.

3.6 INSTALLATION OF ONE-PIECE PVC INSULATED FITTING COVERS

- A. Premolded fitting covers to be precisely cut or mitered to fit or be tucked snugly into the throat of fitting and edges adjacent to pipe covering and taped to form a fully insulated pipe covering.
- B. Use adhesive and/or tape specified for type of insulation to insure a thorough vapor barrier.
- C. Tape ends securely to adjacent pipe covering. Tape to extend over adjacent pipe insulation with an overlap of at least 2-inch on both side.

END OF SECTION

SECTION 230913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 ACTUATORS AND OPERATORS

1.1 General Requirements

- A. Damper and valve actuators shall be electronic, as specified in the System Description section.

1.2 Electronic Damper Actuators

A. Spring Return Actuators:

1. Manufactured, brand labeled or distributed by Belimo, Inc. or approved equivalent.
2. Regulatory Agency Listing: cULus ,CSA C22.2 No. 24-93, and CE marked
3. Direct-Coupled Design: Requires no crankarm or linkage for mounting to a shaft.
4. Coupling: toothed V-bolt clamp and nuts with toothed cradle.
5. Reversible Mounting: Provides either clockwise or counterclockwise operation.
6. Power Failure Operation: Mechanical spring return system drives load to the home position. Other forms of internal energy storage for power failure operation are not acceptable.
7. Motor Technology:
 - (i) Modulating Types: Microprocessor-controlled Brushless DC motor
 - (ii) On/Off Types: DC brush motor.
8. Overload Protection: Electronic stall detection protects from overload at all angles of rotation without the use of end switches.
9. Enclosure Ratings:
 - a) NEMA type 2 / IP54 mounted in any orientation.
10. Double-Insulated construction: Eliminate the need for electrical ground wires.
11. Wiring: Integral cables with colored and numbered conductors.
12. Sized for torque required to seal damper at load conditions
13. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
14. Proportional actuators shall be user configurable without the use of external computer software or programming tools. Calibration, input signal range selection, and control logic reversal shall be selectable with an external mode selection switch.
15. Operating Temperature Range:
 - a) 70 lb·in. Torque and below: -40°F to 140°F
 - b) 71 lb·in. Torque and above: -40°F to 131°F
16. Power Requirements:

- a) Modulating Types:
 - (i) 27 lb·in. Torque and Below: 5VA maximum
 - (ii) 70 lb·in. to 19 lb·in. Torque: 8VA maximum
 - (iii) 89 lb·in. to 71 lb·in. Torque: 10VA maximum
 - (iv) 90 lb·in. to 177 lb·in. Torque: 16VA maximum
 - b) 2-Position Types:
 - (i) 27 lb·in. Torque and Below: 5VA maximum
 - (ii) 70 lb·in. to 19 lb·in. Torque: 7VA maximum
 - (iii) 71 lb·in. to 177 lb·in. Torque: 25VA maximum
- B. Non-Spring Return Actuators:
- 1. Manufactured, brand labeled or distributed by Belimo, Inc. or approved equivalent.
 - 2. Regulatory Agency: UL Listed ,CSA Certified, and CE marked
 - 3. Direct-Coupled Design: Requires no crank arm or linkage for mounting to a shaft.
 - 4. Coupling:
 - a) Above 80 lb·in.: toothed V-bolt clamp and nuts with toothed cradled
 - b) 80 lb·in. and below: single cup-point set screw and toothed cradle.
 - 5. Overload Protection: Electronic stall detection or magnetic slip clutch protects from overload at all angles of rotation without the use of end switches.
 - 6. Minimum Enclosure Ratings:
 - a) Types with covered wiring terminals: NEMA type 2 / IP42 mounted in any orientation.
 - b) Types without covered wiring terminals: NEMA type 1 / IP30 or IP40.
 - c) Types with integrated cables: NEMA 2 / IP42 mounted in any orientation.
 - 7. Sized for torque required to seal damper at load conditions
 - 8. Parallel Operation: Actuators shall be available that are capable of being mechanically or electrically paralleled.
 - 9. Proportional actuators shall be user configurable without the use of external computer software or programming tools.
 - 10. Operating Temperature Range: -4°F to 122°F except for VAV and similar indoor applications in which case 32°F to 122°F is acceptable.
 - 11. Power Requirements: 24 V with models available for both 24 VAC and 24 VDC operation, maximum
 - a) Above 80 lb·in.: 7.5 VA at 24 VAC
 - b) 80 lb·in. and below: 3.5 VA at 24VAC

12. The manufacturer shall provide 5-year limited warranty from the date of sale covering defects in material or workmanship.

PART 2 SENSORS AND TRANSMITTERS

2.1 General Requirements

- A. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

2.2 Temperature Sensors

A. General Requirements:

1. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
2. The temperature sensor shall be of the resistance type and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
3. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Room Temp	$\pm .5^{\circ}\text{F.}$
Duct Temperature	$\pm .5^{\circ}\text{F.}$
All Others	$\pm .75^{\circ}\text{F.}$

B. Room Temperature Sensors

1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have the following options when specified:
 - a) Setpoint warmer/cooler dial or reset slide switch providing a +3 degree (adjustable) range.
 - b) Individual heating/cooling setpoint slide switches.
 - c) A momentary override request push button for activation of after-hours operation.
 - d) Analog thermometer.

C. Room Temperature Sensors with Integral Display

1. Room sensors shall be constructed for either surface or wall box mounting.
2. Room sensors shall have an integral LCD display and either a setpoint adjustment dial or setpoint adjustment push buttons, and the following capabilities when specified:
 - a) Display room air temperatures.
 - b) Display and adjust room comfort setpoint.

- c) Display and adjust fan operation status via push button.
- d) Timed Override request via Occupancy Override push button with LED status for activation of after-hours operation.
- e) Override request via setpoint adjustment dial or setpoint adjustment push buttons for activation of after-hours operation.
- f) Occupancy sensor
- g) F/C toggle pushbutton to toggle between F and C.
- h) RH%/Temperature toggle push button to temporarily display RH%

D. Thermo-wells

- 1. Thermo-well manufacturer shall have models available in stainless steel, brass body, and copper bulb.
- 2. When thermo-wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and sensor.
- 3. Thermo-wells shall be pressure rated and constructed in accordance with the system working pressure.
- 4. Thermo-wells and sensors shall be mounted in a direct mount (no adapter) offering faster installation or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
- 5. Thermo-wells constructed of 316 stainless steel shall comply with Canadian Registration Number (CRN) pressure vessel rating.

E. Outside Air Sensors

- 1. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
- 2. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
- 3. Temperature transmitters shall be of NEMA 3R (IP54) or NEMA 4 (IP65) construction and rated for ambient temperatures.
- 4. The outdoor sensor can be easily mounted on a roof, pole or side of a building utilizing its already assembled mounting bracket.
- 5. Outside Relative Humidity sensors 0-100% full range of accurate measurement. Operating temperature -4 to 140F (-20 to 60C).
- 6. Outside temperature sensors operating temperature range is -40 to 140F, +/- .55F (+/- .3C).

F. Duct Mount Sensors

- 1. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

2. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
3. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

G. Averaging Sensors

1. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
2. For plenum applications, such as mixed air temperature measurements, a continuous averaging sensor or a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
3. Capillary supports at the sides of the duct shall be provided to support the sensing string.

H. Humidity Sensors

1. The sensor shall be a solid-state type, relative humidity sensor of the Thin Film Capacitance or Bulk Polymer Design. The sensor element shall resist service contamination.
2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 degrees F unless specified elsewhere.
4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R (IP54) or NEMA 4 (IP65) enclosure with sealite fittings.
5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

2.3 Differential Pressure Transmitters

A. General Air and Water Pressure Transmitter Requirements:

1. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
2. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

4. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

B. Low Differential Air Pressure Applications (0" to 2.5" w.c.)

1. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
2. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - a) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - b) 4-20 mA, 0-5 VDC, 0-10 VDC, output.
 - c) Maintain accuracy up to 20 to 1 ratio turndown.
 - d) Reference Accuracy: +0.25%, or 0.5% of full span.
 - e) Acceptable Manufacturers: Ruskin, or approved equal

C. Medium Differential Air Pressure Applications (5" to 21" w.c.)

1. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - a) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - b) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - c) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70 degrees F.).
2. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
3. Acceptable manufacturers: Ruskin or approved equal

2.4 Flow Monitoring

A. Air Flow Monitoring

1. Fan Inlet Air Flow Measuring Stations
 - a) At the inlet of each fan and near the exit of the inlet sound trap, airflow sensors shall be provided that shall continuously monitor the fan air volumes or velocity pressure.
 - b) Each sensor shall be surface mount type. Unit shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location through two or four sensing circuits. If a static pressure manifold is used, it shall incorporate dual offset static tips on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20 degrees in the approaching air stream.

- c) Devices creating fan performance degradation, resulting in additional energy consumption, caused from pressure drop associated with probes or mounting apparatus in the center of the fan inlet are not allowed. The device shall not induce a significant pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presence in the air stream. Sensor circuit casings shall be constructed of U.L. 94 flame rated, high impact ABS and include a stainless steel thermistor cap that maintains the precise calibrated flow over the heated and ambient measurement points. Each sensor circuit shall consist of two ceramic base, glass encapsulated, thermistors for measuring ambient temperature and velocity. Circuit shall be designed for operation in a wide range of environments, including high humidity (non-condensing) and rapid thermal cycling.
- d) Acceptable manufacturers are: Air Monitor Corp., Tek-Air Systems, Inc., or Dietrich Standard.

B. Single Probe Air Flow Measuring Sensor

- 1. The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a thermal dispersion and utilize one temperature sensor and a heated thermistor. The sensor pair shall measure the air temperature and airflow velocity.

C. Duct Air Flow Measuring Stations

- 1. Furnish and install, at locations shown on plans or as in accordance with schedules, an equalized air measuring probe system piped to a high performance pressure transducer or an electronic type airflow temperature measuring station.
- 2. Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
- 3. Assembly shall be AMCA tested and capable of measuring a range from 70 to 5,000 FPM (22 to 1524 MPM).
- 4. Equalized air measuring assembly shall measure to $\pm 3\%$ average and consist of 6063T5 extruded aluminum step sensing blade(s) with anodized finish, plenum-rated polyethylene pressure tubing, brass barbed fittings, mounting hardware and a glass-on-silicone capacitance sensor pressure transducer capable of measuring up to five field-selectable pressure ranges up to 2.5 in. w.c.
- 5. The transducer shall be accurate to $\pm 0.5\%$, or 0.25% of full scale and be contained in a National Electrical Manufacturer's Association (NEMA) 4 (IP-65) enclosure. Transducer shall be factory mounted and piped to high and low pressure ports through fittings made of brass.
- 6. All sensor tubing shall terminate in solid brass barbed fittings.
- 7. Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.

8. Air straightener shall be provided for sizes over 17 square feet (1.6 sq. meter).
9. Airflow measuring station assemblies shall be fabricated of galvanized steel or aluminum casing of appropriate thickness for slip fits or with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 5000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
10. Electronic air measuring station shall be capable of monitoring and reporting the airflow and temperature at each measuring location through one or more measuring probes containing multiple sensor points and a control transmitter that outputs a 4-20 mA linear signal.
11. Probe(s) shall be constructed of an airfoil shaped aluminum extrusion containing the sensor circuit(s).
12. Each sensor circuit shall consist of coated thermistors, for temperature and velocity, mounted to a Printed Circuit Board (PCB).
13. Probe multiplexer circuit(s) shall include a microprocessor that collects data from each PCB and digitally communicates the average airflow and temperature of each probe to a microprocessor based control transmitter.
14. Multiplexer board shall be encased to prevent moisture damage.
15. Shielded CAT5e communications cable shall be Underwriters Laboratories Inc.® (UL) plenum-rated with RJ45 terminal connectors. Dust boot covers and gold-plated contacts shall link probes to electronic controller.
16. Control transmitter shall be capable of processing independent sensing points and shall operate on a fused 24 VAC supply.
17. Control transmitter shall feature a 16 x 2 character alphanumeric LCD screen, digital offset/gain adjustment, continuous performing sensor/transmitter diagnostics, and a visual alarm to detect malfunctions.
18. All electronic components of the assembly shall be Restriction of Hazardous Substances (RoHS) Directive compliant.
19. Installation Considerations
 - a) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .04" w.c. at 1000 feet per minute, or .11" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 3-5% as determined by AMCA.
 - b) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be 1.5 inches to facilitate matching connecting ductwork.

- c) Where control dampers are shown as part of the airflow measuring station, parallel blade precision controlled volume dampers integral to the station and complete with actuator, and linkage shall be provided.
 - d) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance with ASME Guidelines affecting non-standard approach conditions.
- 20. All air measuring devices shall be tested according to AMCA Standard 610
- 21. Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ruskin, and Dietrich Standard.
- D. Static Pressure Traverse Probe
 - 1. Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
- E. Shielded Static Air Probe
 - 1. A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.

2.5 Power Monitoring Devices

- A. Current Measurement (Amps)
 - 1. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
 - 2. Current Transformer – A split core current transformer shall be provided to monitor motor amps.
 - a) Operating frequency – 50 - 400 Hz.
 - b) Insulation – 0.6 Kv class 10Kv BIL.
 - c) UL recognized.
 - d) Five amp secondary.
 - e) Select current ration as appropriate for application.
 - 3. Current Transducer – A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - a) 6X input over amp rating for AC inrushes of up to 120 amps.
 - b) Manufactured to UL 1244.
 - c) Accuracy: +.5%, Ripple +1%.
 - d) Minimum load resistance 30kOhm.

- e) Input 0-20 Amps.
- f) Output 4-20 mA.
- g) Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).

2.6 Smoke Detectors

- A. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

2.7 Status and Safety Switches

A. General Requirements

- 1. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

B. Current Sensing Switches

- 1. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
- 2. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
- 3. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

C. Air Filter Status Switches

- 1. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
- 2. A complete installation kit shall be provided including static pressure taps, tubing, fittings, and air filters.
- 3. Provide appropriate scale range and differential adjustment for intended service.

D. Air Flow Switches

- 1. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.

E. Air Pressure Safety Switches

- 1. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.

2. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

F. Low Temperature Limit Switches

1. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
2. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
3. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.8 Control Relays

A. Control Pilot Relays

1. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
2. Mounting Bases shall be snap-mount.
3. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
4. Contacts shall be rated for 10 amps at 120VAC.
5. Relays shall have an integral indicator light and check button.

B. Electronic Signal Isolation Transducers

1. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel) or is to receive as an input signal from a remote system.
2. The signal isolation transducer shall provide ground plane isolation between systems.
3. Signals shall provide optical isolation between systems.
4. Electronic/Pneumatic Transducers
 - a) Electronic to Pneumatic transducers shall provide:
 - (i) Output: 3-15 PSIG.
 - (ii) Input: 4-20 mA or 0-10 VDC.
 - (iii) Manual output adjustment.
 - (iv) Pressure gauge.
 - (v) External replaceable supply air filter.

C. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with

concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 3 CONTROL VALVES

3.1 Ball Valves, 1/2 through 2 in.:

- A. Ball Valves shall have forged brass bodies.
- B. Valves shall have available either Chrome Plated Brass Balls or 300 Series Stainless Steel Balls in all sizes.
- C. Valves shall have available either Nickel Plated Brass Stems or 300 Series Stainless Steel Stems with a blow-out proof stem design in all sizes.
- D. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
- E. Stem seals shall be double EPDM O-rings.
- F. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure and shall be inserted against the casting of the valve.
- G. All ball valves with internal pipe thread end connections shall be rated to 580 psi maximum static pressure at 203°F (95°C) fluid temperature.
- H. All ball valves with sweat end connections or press end connection shall be rated to 300 psig maximum static pressure at 203°F (95°C) fluid temperature.
- I. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
- J. Ball Valves with stainless steel balls and stems shall be rated for use with 15 psig saturated steam.
- K. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
- L. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
- M. Valves shall be maintenance free
- N. Valves shall be provided with a 5 year warranty.
- O. Valves shall be rated for 200 psid close off pressure.
- P. Valve actuators shall be UL-recognized or CSA-certified.

3.2 Ball Valves, 2-1/2 through 4 in. Flanged:

- A. Ball Valves shall have forged brass bodies with ASME Class 150 ductile iron flanges.
- B. Valves shall have 300 Series Stainless Steel Balls.
- C. Valves shall have 300 Series Stainless Steel Stems with a blow-out proof stem design.

- D. Valves shall have Graphite reinforced Polytetrafluoroethylene (PTFE) seats with Ethylene Propylene Diene Monomer (EPDM) O-ring backing.
- E. Stem seals shall be double EPDM O-rings.
- F. Flow Characterization Disk shall be manufactured from Amodel AS-1145HS Polyphthalamide Resin and rated for 50 psid maximum differential pressure.
- G. Flow Characteristics shall be equal percentage on the control port. Bypass port on three-way valves shall have linear flow characteristics.
- H. Valves shall have a maximum leakage specification of 0.01% of maximum flow for the control port, ANSI/FCI 70-2, Class 4 and 1% of maximum flow, bypass port.
- I. All valves shall be rated for service with hot water, chilled water, 50% glycol solutions and rated for use with 25 psig saturated steam.
- J. Two-Way Valves shall be rated for 100 psid close off pressure and Three-Way Valves shall be rated for 50 psid close off pressure.
- K. Valves shall be maintenance free.
- L. Valves shall be provided with a 5 year warranty.
- M. Valve actuators shall be UL-recognized or CSA-certified.

3.3 Butterfly Valves, 2 through 20 in. resilient seat ASME Class 125/150 Flanged:

- A. Butterfly Valves shall have cast iron bodies meeting ASTM A126 Class B requirements and meet ASME class 125/150 flange requirements and shall be fully lugged.
- B. Butterfly Valves seat shall be Ethylene Propylene Diene Monomer (EPDM).
- C. Butterfly Valve disk shall be Ductile Iron with Nylon 11 coating.
- D. Butterfly Valve stems shall be Stainless Steel.
- E. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
- F. All valves shall be rated for service with hot water, chilled water and 50% glycol solutions.
- G. Valves shall be maintenance free.
- H. Valve shall be provided with a 3 year warranty.
- I. Valve electric actuators shall be UL-recognized or CSA-certified.

3.4 Butterfly Valves, High Performance 2-1/2 through 16 in.

- A. Butterfly Valves shall have bodies manufactured from Carbon Steel, ASTM A216 GR WCB/A516 GR 70 and shall be fully lugged per ASME Class 150 or ASME Class 300.
- B. Butterfly Valves seat assembly shall be RPTFE (reinforced polytetrafluoroethylene) and the seat retainer shall be Carbon Steel, ASTM A516 GR 70
- C. Butterfly Valve disk shall be Stainless Steel, ASTM A 351 GR CF8M
- D. Butterfly Valve stems shall be 17-4 PH Stainless Steel, ASTM A564-Type 630

- E. Butterfly Valve Stem Seals shall be One Carbon Fiber Ring and Three TFE Rings
- F. Flow Characteristics shall be equal percentage up to 70° of disk rotation.
- G. All valves shall be rated for service with hot water, chilled water, 50% glycol solutions and 50 psig saturated steam in modulating service or 150 psig saturated steam in two position service.
- H. Butterfly Valves shall meet the performance requirements of ASME Class 150 or Class 300.
- I. Valves shall be maintenance free.
- J. Valves shall be provided with a 3 year warranty.
- K. Valve electric actuators shall be UL-recognized or CSA-certified.

3.5 Globe Valves, Brass, 1/2 through 2 in.

- A. Valves shall have bodies manufactured from a RoHS compliant brass.
- B. Valves shall meet the pressure and temperature requirements of ANSI B16.15, Class 250
- C. Valve stems shall be a 300 Series Stainless Steel.
- D. Valves with brass plug and seat shall have stem seals with Self-Adjusting Ethylene Propylene Rubber (EPR) Ring Pack U-Cups
- E. Valves with Stainless Steel plug and seat shall valve stem seals with Spring Loaded Polytetrafluoroethylene (PTFE) and Elastomer V-Rings
- F. Valves with brass trim shall have a maximum leakage specification of 0.01% of maximum flow per ANSI/FCI 70-2, Class 4 and valves with stainless steel trim shall have a maximum leakage of 0.05% of maximum flow
- G. Flow Characteristics shall be equal percentage for two-way valves and linear for three-way valves.
- H. Valves shall be serviceable without being removed from the pipe.
- I. Valves shall be provided with a 3 year warranty.
- J. Valve electric actuators shall be UL-recognized or CSA-certified.

3.6 Globe Valves, Cast Iron, 2-1/2 through 6 in.

- A. Valves shall have bodies manufactured from cast iron.
- B. Valves shall meet the pressure and temperature requirements of ANSI B16.1, Class 125
- C. Valve stems shall be a 316 Series Stainless Steel.
- D. Valves shall have stem seals with Ethylene Propylene Terpolymer (EPT) Ring Pack U-Cups
- E. Valves shall have a maximum leakage specification of 0.1% of maximum flow per ANSI/FCI 70-2, Class 3
- F. Flow Characteristics shall be equal modified linear.
- G. Valves shall be serviceable without being removed from the pipe.

- H. Valves shall be provided with a 3 year warranty.
- I. Valve electric actuators shall be UL-recognized or CSA-certified.

PART 4 CONTROL DAMPERS

- A. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
- B. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
- C. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
- D. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
- E. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.
 - 1. Acceptable manufacturers are Ruskin CD50 or CD60, and Vent Products 5650.
- F. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.
 - 1. Acceptable manufacturers are: Ruskin CD36, and Vent Products 5800.
- G. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

END OF SECTION

SECTION 23 09 23 – Direct-Digital Control System for HVAC

PART 1 GENERAL

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1.2 Related Documents

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.

- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.3 Definitions

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.
- C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.
- D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- E. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BMS network.
- I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
- J. Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: Personal Computer from a recognized major manufacturer
- L. Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BMS Contractor’s cost to the designated third-party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
- M. Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.

- N. Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- P. Software: The term “software” and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:
- | | | |
|------------------------|---|---|
| 1. ADC | - | Analog to Digital Converter |
| 2. AHJ | - | Authority Having Jurisdiction |
| 3. AI | - | Analog Input |
| 4. AN | - | Application Node |
| 5. ANSI | - | American National Standards Institute |
| 6. AO | - | Analog Output |
| 7. ASCII | - | American Standard Code for Information Interchange |
| 8. ASHRAE
Engineers | - | American Society of Heating, Refrigeration and Air Conditioning |
| 9. AWG | - | American Wire Gauge |
| 10. BTL | - | BACnet Testing Laboratories |
| 11. CPU | - | Central Processing Unit |
| 12. CRT | - | Cathode Ray Tube |
| 13. DAC | - | Digital to Analog Converter |
| 14. DDC | - | Direct Digital Control |
| 15. DI | - | Digital Input |
| 16. DO | - | Digital Output |
| 17. EEPROM | - | Electronically Erasable Programmable Read Only Memory |
| 18. EMI | - | Electromagnetic Interference |
| 19. FAS | - | Fire Alarm Detection and Annunciation System |
| 20. GUI | - | Graphical User Interface |
| 21. HOA | - | Hand-Off-Auto |
| 22. ID | - | Identification |

23. IEEE	-	Institute of Electrical and Electronics Engineers
24. I/O	-	Input/Output
25. IT	-	Information Technology
26. LAN	-	Local Area Network
27. LCD	-	Liquid Crystal Display
28. LED	-	Light Emitting Diode
29. MCC	-	Motor Control Center
30. NC	-	Normally Closed
31. NIC	-	Not In Contract
32. NO	-	Normally Open
33. OWS	-	Operator Workstation
34. OAT	-	Outdoor Air Temperature
35. PC	-	Personal Computer
36. RAM	-	Random Access Memory
37. RF	-	Radio Frequency
38. RFI	-	Radio Frequency Interference
39. RH	-	Relative Humidity
40. ROM	-	Read Only Memory
41. RTD	-	Resistance Temperature Device
42. SPDT	-	Single Pole Double Throw
43. SPST	-	Single Pole Single Throw
44. XVGA	-	Extended Video Graphics Adapter
45. TBA	-	To Be Advised
46. TCP/IP	-	Transmission Control Protocol/Internet Protocol
47. TTD	-	Thermistor Temperature Device
48. UPS	-	Uninterruptible Power Supply
49. VAC	-	Volts, Alternating Current
50. VAV	-	Variable Air Volume
51. VDC	-	Volts, Direct Current
52. WAN	-	Wide Area Network

1.4 BMS Description

- A. The Building Management System (BMS) shall be a complete system designed for scalable implementation from small use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT

staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. All components of the BMS that are connected via field bus or IP network, including the BMS server, supervisory controllers, equipment controllers, user interface software, system and controller programming tools and software applications shall be designed, engineered, and tested to work together as a complete building management system.
- C. BMS system architecture shall support integration of third-party devices using industry accepted protocols such as BACnet, LonWorks, and MODBUS.
- D. All points of operator user interface shall be on standard PCs, laptops, or mobile computing platforms such as tablets and smart phones that do not require the purchase of any special software from the BMS manufacturer. The primary point of interface on these devices will be a standard web browser.
- E. Where necessary and as dictated elsewhere in these Specifications, BMS servers shall be used for providing a location for extensive archiving of historical point and alarm and operator transactions. All data stored will be using a standard data base platform: Microsoft SQL Server Express or Microsoft SQL Server as dictated elsewhere in this specification.
- F. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.
- G. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- H. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- I. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- J. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.

1.5 Quality Assurance

A. General

1. The Building Management System Contractor shall be a BMS manufacturer-owned branch office, or an independent controls contractor who is factory trained and authorized by the BMS manufacturer to sell, service and support the Building Management System specified herein.
2. The BMS Contractor shall have a facility within a 40-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis. The BMS Contractor shall have at this facility factory trained, directly employed and full-time technical staff, spare parts inventory, and all necessary test and diagnostic equipment.
3. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last five (5) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
4. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems and shall be the manufacturer's latest standard of design at the time of bid.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades shall comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA rules that have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
 - a) Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b) Manage the financial aspects of the BMS Contract.
 - c) Coordinate as necessary with other trades.
 - d) Be responsible for the work and actions of the BMS workforce on site.

1.6 References

- A. All work shall conform to the following Codes and Standards, as applicable:
 1. National Electric Code (NEC) and applicable local Electric Code.
 2. Underwriters Laboratories (UL) listing and labels.
 3. UL 864 UUKL Smoke Control
 4. UL 268 Smoke Detectors.
 5. UL 916 Energy Management
 6. NFPA 70 - National Electrical Code.
 7. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 8. American National Standards Institute (ANSI).
 9. National Electric Manufacturer's Association (NEMA).
 10. American Society of Mechanical Engineers (ASME).
 11. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 12. Air Movement and Control Association (AMCA).
 13. Institute of Electrical and Electronic Engineers (IEEE).
 14. American Standard Code for Information Interchange (ASCII).
 15. Electronics Industries Association (EIA).
 16. Occupational Safety and Health Administration (OSHA).
 17. American Society for Testing and Materials (ASTM).
 18. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 19. Americans Disability Act (ADA)
 20. ANSI/EIA 909.1-A-1999 (LonWorks)
 21. ANSI/ASHRAE Standard 135 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.7 Submittals

- A. Shop Drawings, Product Data, and Samples

1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
 - a) BMS network architecture diagrams including all nodes and interconnections.
 - b) Systems schematics, sequences, and flow diagrams.
 - c) Device schedule listing each BMS server, supervisory controller, equipment controller and any other networked devices in the BMS, including device name, device type, network identifier, and device identifier (address).
 - d) Points schedule listing each point in each of the networked devices listed in the device schedule, including point name, point type, point description, and point identifier (address).
 - e) Samples of Graphic Display screen types and associated menus.
 - f) Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - g) Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - h) Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address.
 - i) Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
 - j) Details of all BMS interfaces and connections to the work of other trades.
 - k) Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.8 Record Documentation

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished electronically, and include the following for the BMS provided:
 - a) Table of contents.
 - b) As-built system record drawings. Drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c) Manufacturer's product data sheets or catalog pages for all products including software.
 - d) System Operator's manuals.
 - e) Archive copy of all site-specific databases and sequences.
 - f) BMS network diagrams.
 - g) Interfaces to all third-party products and work by other trades.
 2. The Operation and Maintenance Manual shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.
- B. On-Line documentation: After completion of all tests and adjustments the contractor shall provide a copy of all as-built information and product data to be installed on a customer designated computer workstation or server

1.9 Warranty

A. Standard Material and Labor Warranty:

1. Provide a one-year labor and material warranty on the BMS.
2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at no expense to the Owner.
3. Maintenance of computer Software Programs: The BMS 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 BMS 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.
4. The Owner shall grant to BMS Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

PART 2 PRODUCTS

2.1 General Description

- A. The BMS shall be a complete system designed for scalable implementation from small stand-alone use to large, networked systems. This functionality shall extend into the equipment rooms. Devices residing on the enterprise IT network shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for

coordination with the owner's IT staff to ensure that the BAS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.

- B. The Building Management System shall consist of the following:
 - 1. Programmable equipment controllers, for directly operating and controlling mechanical equipment.
 - 2. Network thermostats, for directly operating and controlling mechanical equipment.
 - 3. Field bus network, for exchanging data between equipment controllers and between equipment controllers and supervisory controllers
 - 4. Supervisory controller(s), for managing networks of equipment controllers and providing supervisory control services
 - 5. Automation network, for exchanging data between supervisory controllers, distributed user interface(s), and BMS server.
 - 6. Application software, for defining the sequence of operation of the BMS.
 - 7. Other components required for a complete and working BMS, including network processing, data storage and communications equipment.
 - C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
 - D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
 - 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
 - 2. The System shall maintain all settings and overrides through a system reboot.
 - 3. The System shall comply with the following International Code Council (ICC) Codes:
 - a) Building Officials and code Administrators International (BOMA) model code
 - b) International Conference of Building Officials (ICBO) model code
 - c) Southern Building Code Congress International (SBCCI) regulations
 - E. Acceptable Manufacturers:
 - 1. Schneider
 - 2. Trane
- 2.2 Programmable equipment controllers
- A. Programmable equipment controllers shall include direct wired input interfaces for monitoring analog and binary signals from field devices.
 - B. Programmable equipment controllers shall include direct wired output interfaces for controlling field equipment.
 - C. Programmable equipment controllers shall include a BACnet MS/TP, IP or optionally N2Open field bus network interface.
 - 1. Programmable equipment controllers shall be BACnet Testing Labs (BTL) certified and be marked with the BTL Label.

2. PROGRAMMABLE equipment controllers shall be tested and certified as a BACnet Application Specific Controller (B-ASC) or as BACnet Advanced Application Controller (B-AAC), to, at a minimum, BACnet Protocol Revision 9.
 3. A BACnet Protocol Implementation Conformance Statement shall be provided for the programmable equipment controllers 10 days prior to bidding.
- D. Programmable equipment controllers shall include an expansion sensor and actuator bus (SA Bus) network interface, for interfacing up to 9 of the following types of devices:
1. Expansion input/output modules
 2. Network sensors (NS-xxx), of the following types and characteristics:
 - a) Network room temperature and humidity sensor(s)
 - (i) The network room temperature and humidity sensors shall be suitable for mounting in an occupied space.
 - (ii) The network room temperature and humidity sensor(s) shall be available in either surface mount or wall mount packaging.
 - (iii) The network room temperature and humidity sensor(s) shall include either screw terminals or 6-pin RJ-style modular jack for SA Bus wiring connections.
 - (iv) The network room temperature and humidity sensor(s) shall have the ability to monitor the following variables as required by the system's sequence of operations:
 1. Zone temperature
 2. Zone humidity
 3. Zone setpoint
 - (v) The network room temperature and humidity sensor(s) shall include the following operator controls:
 1. A backlit Liquid Crystal Display (LCD) to indicate the temperature, humidity and setpoint
 2. An LED to indicate the status of the Override feature
 3. A button to toggle the temperature display between Fahrenheit and Celsius
 4. A button to program the display for temperature or humidity
 5. A button to initiate a timed override command
 6. A dial to change the setpoint or warmer/cooler adjustment.
 - b) Network room CO2 sensor(s):
 - (i) The network room CO2 sensor(s) shall be suitable for mounting in an occupied space
 - (ii) The network room CO2 sensor(s) shall be available in either surface mount or wall mount packaging.
 - (iii) The network room CO2 sensor(s) shall include either screw terminals or 6-pin RJ-style modular jack for SA Bus wiring connections.
 - (iv) The network room CO2 sensor(s) measurement range shall be 0-2,000 ppm.
 - c) Network discharge air temperature sensor(s):

- (i) The network discharge air temperature sensor(s) shall be suitable for mounting in supply or discharge air duct.
 - (ii) The network discharge air temperature sensor(s) shall include a 4 inch or 8 inch duct insertion probe.
 - (iii) The network discharge air temperature sensor(s) shall include 10 foot pigtail type wiring lead.
- d) The network sensor(s) shall transmit the information back to the controller on the sensor-actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - (i) The network sensor(s) shall be BACnet Testing Labs (BTL) certified and be marked with the BTL label.
 - (ii) The network sensor(s) shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - (iii) A BACnet Protocol Implementation Conformance Statement shall be provided for the network sensor(s).
 - (iv) The Conformance Statement shall be submitted 10 days prior to bidding.
- 3. Variable speed drive(s)
- 4. Local display/keypad with the following characteristics:
 - a) The local display/keypad shall allow the user to view monitored points without logging into the system.
 - b) The local display/keypad shall allow the user to view and change setpoints, modes of operation, and parameters.
 - c) The local display/keypad shall provide password protection with user adjustable password timeout.
 - d) The local display/keypad shall be menu driven with separate paths for:
 - (i) Input/Output
 - (ii) Parameter/Setpoint
 - (iii) Overrides
 - e) The local display/keypad shall use easy-to-read English text messages.
 - f) The local display/keypad shall allow the user to select the points to be shown and in what order.
 - g) The local display/keypad shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
 - h) The local display/keypad shall be a minimum of 4 lines and a minimum of 20 characters per line
 - i) The local display/keypad shall have a keypad with no more than 6 keys.
 - j) The local display/keypad shall be panel mountable.
- 5. Air balancing tool

- E. Programmable equipment controllers shall have the capability to execute complex control sequences involving direct wired input/output points as well as input and output devices communicating over the FC Bus or the SA Bus.
- F. Programmable equipment controllers shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
- G. Programmable equipment controllers shall employ a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
- H. Programmable control logic shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.
- I. Programmable equipment controllers shall be fully programmable and definable using a software tool with the following characteristics:
 - 1. A simple, check-the-box or selection-type wizard method, with selections for the most popular HVAC equipment and control strategy options.
 - 2. A graphical, functional logic block editor for creating new or editing existing programming logic.
- J. Programmable equipment controllers shall provide the ability to be downloaded and uploaded either locally or using the communications network. Programmable equipment controllers shall support being loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.
- K. Control setpoint changes initiated over the network shall be written to programmable equipment controllers' non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.
- L. Programmable equipment controllers' firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.
- M. Programmable equipment controllers shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB or the controller is designed and suitable for use in other environmental air space (plenums) in accordance with Section 300.252(C) of the National Electrical Code.
- N. The programmable equipment controllers shall include troubleshooting LED indicators to identify the following conditions:
 - 1. Power On
 - 2. Power Off
 - 3. Download or Startup in progress, not ready for normal operation
 - 4. No Faults
 - 5. Device Fault
 - 6. Field Controller Bus - Normal Data Transmission
 - 7. Field Controller Bus - No Data Transmission
 - 8. Field Controller Bus - No Communication

9. Sensor-Actuator Bus - Normal Data Transmission
 10. Sensor-Actuator Bus - No Data Transmission
 11. Sensor-Actuator Bus - No Communication
- O. Models of programmable equipment controllers dedicated for general purpose shall be provided with the following characteristics:
1. The general-purpose programmable equipment controllers shall support, but not be limited to, the following applications:
 - a) Terminal units
 - b) Packaged rooftop units and heat pumps
 - c) Built-up air handling units
 - d) Chilled water/central plants
 - e) Heating central plants
 - f) Special applications as required for systems control
 2. The general-purpose programmable equipment controllers shall include input interface(s) to monitor the following analog signals, without the addition of equipment outside the controller cabinet:
 - a) 0-10 VDC sensors
 - b) 4-20 mA sensors
 - c) 0-2k ohm resistive temperature detector (RTDs)
 - d) 10k Type L and 2.252k type 2 NTC thermistors
 3. The general-purpose programmable equipment controllers shall include input interface(s) to monitor the following binary signals:
 - a) Dry contact closures, with filtering to eliminate false signals resulting from input "bouncing".
 - b) Pulse Counter/Accumulator Mode (high speed), 100 Hz
 4. The general-purpose programmable equipment controllers' input interfaces shall be internally isolated from power, communications, and output circuits, for noise immunity.
 5. The general-purpose programmable equipment controllers shall include output interface(s) with the following characteristics:
 - a) 0-10 VDC analog output
 - b) 4-20 mA analog output
 - c) SPST triac output rated for 500mA at 24 VAC.
 6. The general-purpose programmable equipment controllers' output interfaces shall be internally isolated from power, communications, and other output circuits for noise immunity.
 7. The general-purpose programmable equipment controllers shall support an optional, display/keypad integrated into the controller's housing face, with the following characteristics:

- a) The integrated display/keypad shall allow the user to view monitored points without logging into the system.
 - b) The integrated display/keypad shall allow the user to view and change setpoints, modes of operation, and parameters.
 - c) The integrated display/keypad shall provide password protection with user adjustable password timeout.
 - d) The integrated display/keypad shall be menu driven with separate paths for:
 - e) Input/Output
 - f) Parameter/Setpoint
 - g) Overrides
 - h) The integrated display/keypad shall use easy-to-read English text messages.
 - i) The integrated display/keypad shall allow the user to select the points to be shown and in what order.
 - j) The integrated display/keypad shall support a back lit Liquid Crystal Display (LCD) with adjustable contrast and brightens and automatic backlight brightening during user interaction.
 - k) The integrated display/keypad shall be a minimum of 4 lines and a minimum of 20 characters per line.
 - l) The integrated display/keypad shall have a keypad with no more than 6 keys.
- P. Models of programmable equipment controllers dedicated for advanced control applications shall be provided with the following characteristics:
- 1. The advanced application equipment controllers shall support, but not be limited to, the following applications:
 - a) Built-up air handling units
 - b) Special applications as required for systems control
 - 2. The advanced application equipment controllers shall include an integral real-time clock which enables them to locally provide the following time-based application services:
 - a) Scheduling
 - b) Alarming
 - c) Trending
 - 3. The advanced application equipment controllers shall continue time-based monitoring when offline from a supervisory controller for extended periods of time.
 - 4. The advanced application equipment controllers shall include input interface(s) to monitor the following analog signals, without the addition of equipment outside the controller cabinet:
 - a) 0-10 VDC sensors
 - b) 4-20 mA sensors
 - c) 0-2k ohm resistive temperature detector (RTDs)
 - d) 10k Type L and 2.252k type 2 NTC thermistors

5. The advanced application equipment controllers shall include input interface(s) to monitor the following binary signals:
 - a) Dry contact closures, with filtering to eliminate false signals resulting from input "bouncing".
 - b) Pulse Counter/Accumulator Mode (high speed), 100 Hz
6. The advanced application equipment controllers shall be internally isolated from power, communications, and output circuits, for noise immunity.
7. The advanced application equipment controllers shall include output interface(s) with the following characteristics:
 - a) 0-10 VDC analog output
 - b) 4-20 mA analog output
 - c) SPST triac output rated for 500mA at 24 VAC.
 - d) SPST relay outputs
 - e) SPDT relay outputs
8. The advanced application equipment controllers' output interfaces shall be internally isolated from power, communications, and other output circuits for noise immunity.

2.3 Network Thermostats

- A. The network thermostat shall be capable of controlling the following applications:
 1. Two- or four-pipe fan coils
 2. Cabinet unit heaters
 3. Pressure dependent variable air volume box
 4. Zoning systems employing reheat including local hydronic reheat valves, or other similar equipment
 5. Split air or packaged units of the following types
 - a) Cooling only
 - b) Cooling units with gas or electric heat
 - c) Heat pumps
 - d) Units with economizers
- B. The network thermostat shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.
 - a) Communications shall be selectable locally at thermostat through the touchscreen display
- C. The network thermostat shall be BACnet Testing Labs (BTL) certified and be marked with the BTL Label.
 1. The network thermostat shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 2. A BACnet Protocol Implementation Conformance Statement shall be provided for the network thermostat.

- D. The network thermostat shall include a (minimum) 4.0-inch LED backlit touch screen with the following configurable icons.
1. Home screen configurable icons include
 - a) On/Off icon
 - b) Fan override icon
 - c) Zone temperature icon
 - d) Hold temperature icon
 - e) Zone humidity (on applicable models) icon
 - f) Occupancy status (on applicable models) icon
 - g) Temperature setpoint icon
 - h) Alarm icon
 - i) Unit status icon
 - j) Date/Time icon
 - k) Fan override icon
 2. Home screen non-configurable icon includes
 - a) Menu icon
- E. The network thermostat shall provide the flexibility to support any one of the following inputs:
1. Integral indoor air temperature sensor
 2. Analog input for remote air temperature sensing that supports the following sensor types
 - a) Nickel
 - b) Platinum
 - c) A99B PENN
 - d) 2.25k ohm NTC
 - e) 10k ohm NTC
 - f) 10k ohm NTC Type 3
 3. Universal input that supports the following configurations
 - a) Analog sensor
 - b) Cooling when switch is closed
 - c) Heating when switch is closed
 4. Remote indoor air temperature sensor
 5. Analog input that supports the following configurations.
 - a) Supply temperature sensor
 6. Two configurable binary inputs with the following configurations
 - a) Disabled
 - b) Occupancy

- c) Override
- d) Remote PIR
- F. The network thermostat shall employ nonvolatile electrically erasable programmable read-only memory (EEPROM) for all adjustable parameters.
- G. The network thermostat shall have a temperature accuracy of $\pm 0.9^{\circ}\text{F}/\pm 0.5^{\circ}\text{C}$ at $70.0^{\circ}\text{F}/21.0^{\circ}\text{C}$ typical calibrated
- H. The network thermostat shall have a humidity accuracy of $\pm 5\%$ RH from 20 to 80% RH at 50 to 90°F (10 to 32°C)

2.4 FIELD BUS NETWORK

- A. The field bus network shall support communications and data exchange between the equipment controller(s) and the supervisory controller(s).
- B. The field bus network shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
- C. The field bus network cabling shall be 22 AWG, stranded, 3-wire twisted, shielded cable.
- D. End of line (EOL) termination shall be used on the two devices located at either end of each field bus network segment.
- E. The field bus network shall support a maximum 3 bus segments.
- F. A field bus network segment shall support a maximum of 32 devices.
- G. The field bus network shall support a maximum of 64 total devices.
- H. Each field bus network segment shall be up to 1,220 m (4,000 ft) in length.
- I. Each field bus network shall be up to 3,660 m (12,000 ft) in length.
- J. End of line (EOL) termination shall be used on the two devices located at either end of each field bus network segment.

2.5 SUPERVISORY CONTROLLER(S)

- A. Supervisory controller(s) shall provide network management services between itself and the equipment controllers which are connected to its communications trunks, between itself and other supervisory controllers, and between itself and any user interface clients that are part of the BMS.
- B. Supervisory controller(s) shall be enabled to support and shall be licensed with the following open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. LonWorks
 - 3. MODBUS
 - 4. SNMP
 - 5. KNX
- C. Supervisory controller(s) shall perform control and operating strategies for the system based on information from any equipment controller connected to the BMS, including but not limited to the following:
 - 1. Scheduling, including calendar functions

2. Historical data collection, management, and visualization
 3. Alarm initiation, routing, and notification
 4. Time synchronization
 5. Managing the exchange of data between itself and equipment controllers
 6. Closed loop control and interlocking
- D. Supervisory controllers shall be capable of peer-to-peer communications with other supervisory controllers and with any user interface client connected to the BMS, whether the user interface client is directly connected, connected via cellular modem or connected via the Intranet or Internet.
- E. The communication protocols utilized for peer-to-peer communications between supervisory controllers shall be Niagara 4 Fox, BACnet TCP/IP or SNMP. Use of a different communication protocol for peer-to-peer communications between supervisory controllers is not allowed.
- F. The supervisory controller(s) shall employ a device count capacity license model that supports expansion capabilities.
- G. The supervisory controller(s) shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two isolated RS-485 ports with biasing switches.
 3. 1 GB RAM
 4. 4 GB Flash Total Storage / 2 GB user storage
 5. Wi-Fi (Client or WAP)
 6. USB flash drive
 7. High speed field bus expansion
 8. -20-60 degrees C ambient operating temperature
 9. Integrated 24 VAC/DC global power supply
 10. MicroSD memory card employing Encrypted Safe Boot Technology
- H. The supervisory controller(s) shall include an embedded web server to support standard web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- I. The supervisory controller(s) shall provide alarm generation, storage, routing, management and analysis to data sourced from equipment controllers, network thermostats, and direct field inputs, including the following capabilities:
1. Alarming capability shall support being added to any data point in the supervisory controller's database.
 2. User-defined criteria shall be used to define when the point meets an alarm condition (is in an alarmed state), including, but not limited to the following:
 - a) For numeric-type data points: when the data point's value falls outside a user-defined range.
 - b) For Boolean or enumerated type data points: when the data point's state matches a user defined alarm state.

- c) For string-type data points, when the data point's string text includes or excludes a user-defined string text.
 - d) For commanded points, when the data point's actual value does not match its commanded value after an appropriate (user-defined) time delay.
 - 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements, including but not limited to:
 - a) To alarm.
 - b) Return to normal.
 - c) To default.
 - 4. Each alarm record shall include at a minimum, the following information:
 - a) Name of source data point
 - b) Time and date of alarm occurrence
 - c) Acknowledge time, date, and user who issued acknowledgement
 - 5. Routing of alarms shall be user-defined, and may include one or more of the following destinations:
 - a) A dynamically-updated alarm console on the distributed user interface screen.
 - b) A bound, animated symbol on the distributed user interface screen.
 - c) Email
 - d) Pagers, using paging services that initiate a page-on receipt of email message.
 - e) SMS text message
 - f) Line printer
 - g) Another supervisory controller or a BMS Server for alarm centralization and/or archival
 - 6. Alarms that have gone unacknowledged by the specified contact for a specified time shall re-routed to the next specified contact.
 - 7. Alarms shall support customized text instructions to be assigned to them, so that any time an alarm is generated, the instructions are included and presented along with the alarm notification to guide the operator on how to recover from the alarm condition.
 - 8. Authorized operators shall be allowed (and optionally required) to add a note to one or more alarm records simultaneously to provide historical context for the event that triggered the alarm.
 - 9. Authorized operators shall be allowed to acknowledge alarms using the alarm console on the user interface.
 - 10. Authorized operators shall be allowed to silence the audible alarm sound on the alarm console.
 - 11. Authorized operators shall be allowed to delete alarm records from the alarm database but only after the alarms have been acknowledged and the source data point is in a normal (no longer in alarm) state.
- J. The supervisory controller(s) shall support the following security functions to prevent unauthorized access:

1. The supervisory controller(s) shall use module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. The supervisory controller(s) shall use Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. The supervisory controller(s) shall require strong user passwords.
 4. All data in motion and sensitive data at rest in the supervisory controller(s) shall be encrypted.
 5. The supervisory controller(s) shall support LDAP and Kerberos integration of access management.
- K. The supervisory controller(s) shall support tagging to utilize Search, Hierarchy, and User Permission functionality.
- L. The supervisory controller(s) shall provide scheduling capabilities being added to any writable data point in the supervisory controller's database, sourced from any equipment controllers, network thermostats, and direct field inputs, including the following capabilities:
- M. The supervisory controller(s) shall support scheduling on a weekly and special event basis.
1. Authorized operators shall be allowed to view and adjust the exact start/stop time and dates for the weekly schedule and special events from the user interface.
 2. The supervisory controller(s) shall support sharing schedule configurations with other supervisory controller(s), with the BMS server, and with scheduling-enabled BACnet devices.
- N. The supervisory controller(s) shall support data logging capabilities being added to any data point in the supervisory controller's database, sourced from any equipment controllers, network thermostats, and direct field inputs, including the following capabilities:
1. Data logs shall be organized into ordered collections of timestamped records, herein called histories.
 2. Each history record shall include at a minimum, the following information:
 - a) History name
 - b) Data point value
 - c) Time and date when data point was logged
 3. User-defined criteria shall be used to define when the data point is logged, including, but not limited to the following:
 - a) When the data point's value, state, or string changes by a user-defined amount.
 - b) At a regular, repeating, user-defined time intervals.
 4. The supervisory controller shall support user-specified local storage capacity for the history records. The data logging behavior upon reaching the specified capacity shall be user-selectable from the following options:
 - a) Stop: terminate recording.
 - b) Roll: overwrite older records with newer ones.
 5. Histories shall support being viewed by operators in a table or chart format on the user interface.

6. The supervisory controller shall support the automatic exporting of one or more histories to the BMS server for long term archival.
- O. The supervisory controller's configuration software shall be embedded into the supervisory controller, enabling an authorized user to access the configuration software using a web browser.
- P. The supervisory controller shall be provided with a 5 year software maintenance license. Labor to implement not included.

2.6 Automation Network

- A. The automation network shall be based on a IT industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
- B. The BMS shall network multiple user interface clients, supervisory controllers, and equipment controllers. Provide BMS server as required for systems operation.
- C. All BMS devices on the automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
- D. Supervisory controllers and BMS server shall reside on the automation network.
- E. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

2.7 Distributed user interface(s)

- A. Connect to and provide required graphics for existing BAS user interface.
- B. The distributed user interface shall include the following features to allow operators to quickly find information within the system:
 1. A navigation tree listing a hierarchy of system components, including devices and data points.
 2. Graphical, floor plan view of the building's spaces, embedded with dynamic links to the views of the equipment, devices, and data points serving those spaces.
- C. The distributed user interface shall provide authorized operators with the following information about each data point in the system database:
 1. Identification
 2. Present value
 3. Status, including normal, overridden, offline, and in alarm.
- D. The distributed user interface shall provide authorized operators a check-the-box method to add alarm, trend, and totalization extensions to any data point in the system.
- E. The distributed user interface shall include the following point summaries to allow operators to quickly view data points that share certain attributes:
 1. All point summary
 2. Points-in-alarm summary
 3. Points-in-override summary
 4. Points-offline summary

5. Non-normal points summary
- F. The distributed user interface shall allow authorized operators to manually command writable data points in the system as part of a 16-level priority write method, defined as:
 1. 1-Emergency/Life Safety Manual Command
 2. 2-Automatic Life Safety
 3. 3-User Defined
 4. 4-User Defined
 5. 5-Critical Equipment Control
 6. 6-Minimum On/Off
 7. 7-User Defined
 8. 8-Override (Manual Operator Command)
 9. 9-Demand Limiting
 10. 10-User Defined
 11. 11-Temperature Override
 12. 12-Stop Optimization
 13. 13-Start Optimization
 14. 14-Duty Cycling
 15. 15-Outside Air Optimization
 16. 16-Schedule
- G. The distributed user interface shall allow authorized operators to issue temporary (adjustable time) or permanent manual commands to writable data points in the system.
- H. The distributed user interface shall include an alarm console for authorized users to perform the following alarm management functions:
 1. Authorized operators shall be allowed to view all alarms routed to the alarm console, with the following information:
 - a) Time stamp
 - b) Source state
 - c) Acknowledge state
 - d) Source
 - e) Alarm class
 - f) Priority
 - g) Message text
 2. Authorized operators shall be allowed to apply the following filters to include or exclude alarms shown on the alarm console:
 - a) Source state
 - b) Acknowledge state

- c) Acknowledge required
 - d) Source
 - e) Alarm class
 - f) Priority
 - g) Normal time range
 - h) Acknowledge time range
 - i) User
 - j) Alarm data
 - k) Alarm transition
 - l) Last update time range
3. Authorized operators shall be allowed to acknowledge alarms, either individually or in bulk using the Shift or Ctrl keys.
 4. Authorized operators shall be allowed to select an alarm occurrence in the alarm console and link to the view in the system showing the alarm source.
 5. Authorized users shall be allowed to add a note to one or more alarm records simultaneously to provide historical context for the event that triggered the alarm.
 6. Authorized operators shall be allowed to silence the audible alarm for one or more alarm sources.
- I. The distributed user interface shall include an alarm database maintenance view for authorized users to delete alarm records from the alarm database, but only after the alarms have been acknowledged and the alarm source has returned to a normal (no longer in alarm) state.
- J. The distributed user interface shall include a history chart view for operators to view historical and live data in a chart over time.
1. The distributed user interface shall allow authorized operators to customize the appearance of the history charts in on or more of the following ways:
 - a) Chart type included any one of the following:
 - (i) Line chart
 - (ii) Area chart
 - (iii) Bar chart
 - (iv) Stacked bar chart
 - (v) Discrete line chart
 - (vi) Discrete area chart
 - (vii) Pie chart
 - b) X and Y axis range
 - c) Data, background, and status colors
 - d) Axis orientation
 - e) Data source zooming

- f) Turning the chart grid on/off
 - g) Data popups
- 2. The distributed user interface shall allow operators to view multiple data points simultaneously per history chart.
- 3. The distributed user interface shall provide a “time zone-less” time range configuration so that operators can plot each history chart with reference to its own time zone, resulting in charts that are aligned by local time.
- K. The distributed user interface shall include a history database maintenance view allowing authorized users to delete history records from the history database.
- L. The distributed user interface shall allow authorized operators to export selected histories as either a table of data in a comma separated variable (*.csv) format or as the selected chart view.
- M. The distributed user interface shall allow authorized operators to view, define, and change the normal, regular, and repeating events in the system schedule using a weekly scheduler view.
- N. The distributed user interface shall allow authorized operators to view, define, and change partial day exceptions to the system schedule.
- O. The distributed user interface shall include a calendar view to allow operators to define and change the special events in the system schedule.

2.8 System Tools

A. Supervisory Controller Configuration Tool

- 1. The supervisory controller configuration tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a supervisory controller or BMS server.
- 2. The supervisory controller configuration tool shall create a station database for the configuration and application data.
- 3. The supervisory controller configuration tool shall have the same look-and-feel as the distributed user interface, regardless of whether the configuration is being done online or offline.
- 4. The supervisory controller configuration tool shall include the following features:
 - a) System component navigation tree for configured networks
 - b) Integration of BACnet, N2, Lonworks, MODBUS, and supported 3rd party integrated devices
 - c) Configuration of customized user navigation trees
 - d) Graphic view design, layout, and data source binding
 - e) Alarm and event configuration
 - f) Historical data management configuration
 - g) Schedule configuration
 - h) Graphical logic connector tool for custom programming
 - i) Copying, transferring, and archiving databases

5. The supervisory controller configuration tool shall have the capability to automatically create the following station components
 - a) Devices
 - b) Points
 - c) Default trend, alarm, and totalization extensions
 - d) Graphic views

B. Programmable Equipment Controller Configuration Tool

1. The programmable equipment controller configuration tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool.
2. The programmable equipment controller configuration tool shall contain a library of designed and tested applications with a check-the-box application option selector.
3. The programmable equipment controller configuration tool shall contain a logic editor to allow creation of new and editing of existing applications.
4. The programmable equipment controller configuration tool shall support running in a Simulation Mode to verify the configuration prior to downloading to a live controller.
5. The programmable equipment controller configuration tool shall support running in a Commissioning mode to verify the configuration while running in a live controller.
6. The programmable equipment controller configuration tool shall support the following connection methods from the PC hosting the tool to the programmable equipment controllers:
 - a) Through a Bluetooth Commissioning Converter
 - b) Through the supervisory controller, when configured for BACnet routing.

2.9 Miscellaneous Devices

A. Local Control Panels

1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance.
2. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
3. Control panels shall include keyed lock.
4. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
5. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
6. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
7. All wiring shall be neatly installed in plastic trays or tie-wrapped.
8. A 120-volt convenience outlet, fused on/off power switch, and required transformers shall be provided.

B. Power Supplies

1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
2. Input: 120 VAC +10%, 60Hz.
3. Output: 24 VDC.
4. Line Regulation: +0.05% for 10% line change.
5. Load Regulation: +0.05% for 50% load change.
6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
8. A power disconnect switch shall be provided next to the power supply.

PART 3 PERFORMANCE/EXECUTION

3.1 BMS Specific Requirements

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project

C. Actuation / Control Type

1. Primary Equipment
 - a) Controls shall be provided by equipment manufacturer as specified herein.
 - b) All damper and valve actuation shall be electric.
2. Air Handling Equipment
 - a) All air handlers shall be controlled with a HVAC-DDC Controller
 - b) All damper and valve actuation shall be electric.
3. Terminal Equipment:
 - a) Terminal Units (VAV, UV, etc.) shall have electric damper and valve actuation.
 - b) All Terminal Units shall be controlled with a HVAC-DDC Controller.

3.2 INSTALLATION PRACTICES

A. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring

- shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
 3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
 4. Class 2 Wiring
 - a) All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b) Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
 5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- B. BMS Line Voltage Power Source
1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
 2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
 3. DDC terminal unit controllers may use AC power from motor power circuits.
- C. BMS Raceway
1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
 3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- D. Penetrations
1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
 2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E. BMS Identification Standards

1. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

F. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.

H. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Duct Temperature Sensors:
 - a) Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b) The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c) For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d) The sensor shall be mounted to suitable supports using factory approved element holders.
6. Space Sensors:
 - a) Shall be mounted per ADA requirements.
 - b) Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
7. Low Temperature Limit Switches:
 - a) Install on the discharge side of the first water or steam coil in the air stream.

- b) Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c) For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
- 8. Air Differential Pressure Status Switches:
 - a) Install with static pressure tips, tubing, fittings, and air filter.
- I. HVAC Output Devices
 - 1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
 - 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 - 3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 - 4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 - 5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3 Training

- A. The BMS contractor shall provide the following training services:
 - 1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

END OF SECTION

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and pipe fittings for:
 - 1. Heating water piping system.
 - 2. Chilled water piping system.
 - 3. Equipment drains and overflows.
- B. Valves:
 - 1. Globe or angle valves.
 - 2. Ball valves.
 - 3. Butterfly valves.
 - 4. Check valves.

1.2 GENERAL REQUIREMENTS

- A. Where more than one piping system material is utilized, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded connections to valve bodies, equipment or other apparatus.
- D. Except where shown otherwise, use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Use ball or butterfly valves for throttling, bypass, or manual flow control requirements for water systems if special valves or fittings are not indicated.
- F. Use spring loaded check valves on discharge of pumps when piped in parallel.
- G. Use lug type butterfly valves to isolate equipment.
- H. Use 3/4 inch ball valve with cap for drains at low points of piping, bases of vertical risers, and at equipment.
- I. All piping and fittings to be made in USA.

1.3 REFERENCES

- A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Braising Operators.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ASME B31.9 - Building Services Piping.
- D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc coated Welded and Seamless.
- E. ASTM A234 - Piping Fitting of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- F. ASTM B32 - Solder Metal.

G. ASTM B88 - Seamless Copper Water Tube.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers. Protect machined surfaces.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 All piping material shall be manufactured in the USA.

2.2 HEATING WATER, CHILLED WATER, ABOVE GROUND

- A. Steel Pipe: ASTM A53, Schedule 40, (0.375 inch (10 mm) wall for sizes 2-1/2 inch (300 mm) and over,) black.
 - 1. Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding typed fittings
 - 2. Joints: Threaded, or welded.
- B. Copper Tubing: ASTM B88, Type L hard drawn for pipe sizes 2" and smaller.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder, wrought copper.
 - 2. Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Drains
 - 1. Copper tubing, ASTM B-88, Type L hard drawn.
 - a) Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - b) Joints: Solder, lead free 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

2.4 UNIONS, FLANGES, AND COUPLING

- A. Union for Pipe 2 inches and Under:
 - 1. Ferrous Piping: 150 psig malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe Over 2 inches
 - 1. Ferrous Piping: 150 psig forged steel, slip-on.
 - 2. Copper Piping: Bronze.
 - 3. Gaskets: 1/16 inch thick preformed neoprene.

2.5 VALVES:

- A. Furnish and install all valves as called for, shown on drawings or as required for proper operation and servicing of the equipment. Valves shall be of manufacturer as noted or equivalent.
- B. Butterfly valves; "bubble tight" at 150 psi and 200 degrees. Construction shall be:
 - 1. Body - Ductile Iron
 - 2. Seat - E.P.D.M.

3. Disc - Ductile iron or aluminum-bronze
 4. Stem - 304, 316 or 17-4PH S.S.
 5. Hammond 6000 Series, Victaulic, Nibco LD-1000 or equivalent
 6. Provide 9" lever handle with infinitely adjustable throttling plate with lock nut and memory stop. Valves in insulated piping shall have 2" extended neck. VALVES 8" and larger; screw or gear operator. All butterfly valves shall be "lug" type for bolting to a standard flange.
- C. Ball Valves - 600# W.O.G., 3-piece, full port
1. Body - Bronze
 2. Seat - Teflon
 3. Ball - 304 or 316 stainless steel
 4. Stem - 304 or 316 stainless steel
 5. O-Ring - Viton or Teflon
 6. Hammond 8303, Victaulic, Nibco 595-Y-66 or equivalent
 7. Valves in insulated piping; 2" extended neck.
- D. Globe valves 0-2" - 300# Bronze, Rising Stem
1. Body - Bronze
 2. Stem - Silicon Bronze
 3. Disc - Bronze
 4. Handwheel - Malleable iron
 5. Packing - Teflon impregnated, asbestos-free
 6. Hammond IB412, Nibco T-275 or equivalent
- E. Globe valves over 2" - 125# O.S.&Y, Resing Stem
1. Body - Iron
 2. Stem - Brass or Bronze
 3. Disc - Bronze
 4. Seat Ring - Bronze
 5. Yoke Bushing - Bronze
 6. Packing - Teflon impregnated, asbestos-free
 7. Hammond IR116, Nibco F-718-B or equivalent
- F. Swing Check Valves 0 - 2" - 150# bronze
1. Body - Bronze
 2. Disc - Bronze
 3. Hammond IB 904, Nibco T-433 or Victaulic equivalent
- G. Swing Check Valves 2" and over - 125# iron
1. Body - Iron

2. Disc - Bronze
3. Seat ring - Bronze
4. Hammond IR1124, Nibco F-918 or Victaulic equivalent

H. Non-slam check valves

1. Body - Iron
2. Disc - Bronze
3. Seat - Bronze
4. Spring - Stainless Steel
5. Mueller No. 105, Williams-Hagen, Victaulic or equivalent

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Make piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. After completion, fill, clean, and treat systems. Refer to Section 232500

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All chilled and hot water piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 150 psig for a minimum period of 24 hours. This hydrostatic test shall be witnessed by the Engineer.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space, and not interfere with use of space and other trades.
- E. Group piping whenever practical at common elevations
- F. Sleeve pipe passing through masonry partitions, walls and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 3. Where inserts are omitted, drill concrete slab from below and provide expansion anchor or use an appropriate powder driven stud where permitted.
- J. Pipe Hangers and Supports:
 1. Install in accordance with ASTM B31.9.
 2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 4. Place hangers within 30 inches of each horizontal elbow or tee.
 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Arrange hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed insulated parallel and at same elevation, provide trapeze hangers.
 8. Prime coat exposed steel hangers and supports and prepare for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- L. Provide access where valves and fittings are not exposed.
- M. Slope piping and arrange system to drain at low points. Use eccentric reducers to maintain proper grade.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Pipe Joints: Unless otherwise specified, join pipes as follows:
1. Steel pipe 2" and smaller, screwed joints
 2. Steel pipe 2-1/2" to 4", screwed or welded joints
 3. Steel pipe 4" and larger, welded or flanged joints.
 4. For welded joints, use only welding type fittings and welding neck flanges with the following exception:
 - a) "Weldolet" or "Threadolet" type of welding fittings for intersection welding of small branches to mains may be used where branch is two-pipe sizes smaller than the main.
 5. Threaded black steel nipples are permitted for drains, vents and pressure gauge taps where provided in black steel systems (pipe sizes 2-1/2" and above). Note: any nipples 1" or smaller shall be provided as Schedule 80 constructions.
- Q. Do not make direct welded connections to valves, expansion joints, strainers, apparatus, or any other units which are intended to be removable.
- R. Copper tube, Type "K" and "L" shall have soldered joints with sweat joint type bronze or copper fittings up through 1-1/2" size. Fitting sizes 2" and larger shall be brazed joints. Flared joints with flare type bronze fittings may be used where approved for specific service.
- S. For screwed joints, use Teflon tape or approved pipe joint compound; apply only on male threads.
- ### 3.3 SCHEDULES
- A. Pipe Hanger Spacing.

Pipe Size Inches	Max Hanger Spacing Feet	Diameter Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
8 to 12	12	7/8
14 and Over	12	1
Non-metallic (All Sizes)	6	3/8

END OF SECTION

SECTION 23 21 16 – HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air vents.
- B. Expansion Tanks
- C. Air Separators
- D. Strainers.
- E. Flow controls.
- F. Pressure Reducing Valves.
- G. Relief valves.
- H. Flexible coupling.

1.2 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of three years' experience.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 AIR VENTS

- A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with one-piece, 1/4" ball valve at top of chamber.

2.2 EXPANSION TANKS

- A. Construction: System Connection – Forged Steel, Shell – Carbon Steel, Bladder – Heavy Duty Butyl Rubber, Designed and constructed per ASME section VIII, Division I. The tank shall be fitted with lifting rings and a floor mounted skirt for vertical installation.
 - 1. Provide pre-charged steel expansion tank with replaceable heavy duty Butyl rubber bladder/diaphragm.
 - 2. Provide charging valve to facilitate on-site charging of the tank to meet system requirements. Charge bladder tanks to minimum fill pressure as shown on plans.

2.3 AIR SEPARATORS

- A. Combination Air Separators/Strainers:
 - 1. Steel, tested and stamped in accordance with ASME SEC 8-D for 1125 psig operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.4 STRAINERS

A. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psig working pressure, basket pattern with 1/8 in stainless steel perforated screen.

2.5 AUTOMATIC FLOW CONTROLS

- A. Automatic Flow Control Valves: Automatic flow control valve cartridges shall automatically control flow rates with +/- 5% accuracy over an operating pressure differential range of at least 14 times the minimum required for control. Valve internal control mechanism shall consist of a stainless steel one piece cartridge with segmented port design and full travel linear coil spring. Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance. All flow control valve cartridges shall be warranted by the manufacturer for five years. Meter kit shall be provided as a single hose portable or double hose portable kit; pressure gauge with 4.5" dial shall have a range of -14.7 to 150 psig. Kit shall have end connections for either pressure or pressure/temperature test valves and shall include carrying cases. All kits shall include flow rate chart for determining flow rate.

2.6 PRESSURE REDUCING VALVE

- A. Iron body, low inlet pressure check valve, removable strainer. 125 psi working pressure.

2.7 RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.8 FLEXIBLE COUPLINGS & VIBRATION ISOLATION

- A. Rotating and reciprocating equipment provided with suitable vibration isolating system. Isolation for all equipment above the ground floor designed for at least 95% absorption efficiency. Select isolators for proper loading to obtain desired efficiency.
- B. Provide flexible duct connections at inlet and outlet of all fans or cabinets containing fans.
- C. Piping connections to pieces of equipment containing rotating or reciprocating machinery (except inline pumps) provided with isolators to prevent transmission of vibration or noise to building structure. Water lines shall be provided with flexible Teflon coupling designed for service and operating pressure. Flexible metal hose shall be of approved design. Where such flexible connections do not accomplish full desired result, piping shall be suspended by means of properly loaded and distributed vibration eliminators design for support rods.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- C. Provide manual air vents at system high points and as indicated.
- D. Provide air separator on suction side of system pumps and connect to expansion tank.
- E. Provide valved drain and hose connection on strainer blow down connection.

- F. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- H. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- I. Select equipment relief valve capacity to exceed rating of connected equipment.
- J. Pipe relief valve outlet to nearest floor drain.

END OF SECTION

SECTION 23 21 23 – PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish and install centrifugal type pumps with the following characteristics:

1. Inline pump.
2. Close coupled.
3. Bronze fitted.
4. Non-overloading.
5. Single-stage.

1.2 QUALITY ASSURANCE

- A. Pump manufacturer accept responsibility for performance and operation at specified conditions and compatibility of components consisting of pump, motor, coupling, and base plate.
- B. Motor HP indicated on schedule to allow non-overloading operation of pump.
- C. Pumps requiring larger motors are not acceptable.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Bell & Gossett
- B. Armstrong
- C. Taco

2.2 CENTRIFUGAL VERTICAL IN-LINE PUMPS:

- A. Provide Vertical In-Line pumps, single stage, single or double suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows, heads, motor speed, enclosure, efficiency and power requirements.
- B. Pump Casing - Cast iron for working pressure below 175 psig at 150°F (125 psig ANSI flange rating) or 1-1/2 times the actual discharge pressure (pump head plus static head) whichever is greater. Suction and Discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections. Pressure classification of flange connection shall correspond to casing work pressure. High points of pump casing provided with air vent cocks. Where pumps are insulated, extend vent cocks outside insulation.
- C. Impellers shall be cut to provide capacities called for in schedules.
- D. The contractor shall have the impellers trimmed to match actual flow conditions on all pumps 10 H.P. and greater after the system is balanced to minimize throttling losses per NC State Building Code, current edition.
- E. Fully bronzed fitted with enclosed impellers dynamically balanced. Bronze wearing ring or impeller runners provided on the suction side of the impellers.
- F. Shafts stainless steel.
- G. Coupling - Rigid spacer type of high tensile aluminum alloy. Couplings shall be split to allow removal from pump and motor shafts, leaving space between the shafts sufficient to replace all mechanical seal components without disturbing the pump or motor.

- H. ECM Motor (if below 1HP) - Shall adjust the motor speed to match flow and head requirements as determined by the test and balance contractor. The user interface shall allow for both manual adjustment or remote control via 0-10 VDC input/output.
- I. Motor sized not to overload at any point within the operating range of impeller and piping system.
- J. Provide and install circuit breaker to match motor.

2.3 MECHANICAL SEALS

- A. All metal parts 304 stainless steel with Buna-N Elastomers, ceramic seat, and carbon seal ring.
- B. For Split Coupled Pumps, shall be ceramic type with stationary seats. Provide factory installed flush line with manual vent.
- C. Suitable for 225° F continuous operation.

2.4 NAMEPLATE

- A. Provide pump and motor with stainless steel nameplate securely fastened to casing.
- B. Nameplates to provide all data necessary for equipment identification and replacement.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installer must examine areas and conditions under which pumps shall be installed, and notify Contractor in writing of those conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been in a manner acceptable to Installer.
- B. Install pumps where shown, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
- C. Provide pumps with base plates or feet carefully leveled and bolted in place on concrete pads or foundations with vibration isolation devices as specified or shown on drawings.
- D. Grout bedplates with expanding type grout containing catalyzed metallic aggregate.
- E. After grout has set, cut flush with bedplate and seal to prevent deterioration at edges.
- F. Provide Suction Diffusers on each pump unless specifically noted otherwise.
- G. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
- H. Provide air cock and drain connection on horizontal pump casings. Provide drains for bases and seals.
- I. Provide drains for bases and seals.
- J. Manufacturer's representative and/or technician certified by the manufacturer shall be required to provide alignment of motor and pump, a laser alignment tool is required for this service. The pump and motor shall be aligned in the vertical angular, horizontal angular, vertical parallel and horizontal parallel. The alignment shall be within the recommended value by pump manufacturer but not over 0.002 (in) parallel and 0.005 (in) angular per radius inch. A printout of the alignment procedure, the pump manufacturer's alignment specifications, and the correct alignment shall be provided to the engineer.

- K. The contractor shall record and submit all results of alignment procedure and the pump manufacturer's alignment specifications to the design engineer. The specifications should also require this approved submittal information is included in the O&M Manual.

END OF SECTION

SECTION 23 25 00 – CHEMICAL WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical treatment.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years' experience. Company shall have local representatives with water analysis laboratories and full-time service personnel.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non potable chemicals to building mechanical systems, and for to public sewage systems.

1.5 MAINTENANCE MATERIALS

- A. Provide sufficient chemicals for treatment and testing during warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

- A. System Cleaner:
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
 - 2. Biocide ; chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
- B. Closed System Treatment (Water):
 - 1. Sequestering agent to reduce deposits and adjust pH.
 - 2. Corrosion inhibitors.
 - 3. Conductivity enhancers.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to extended operation, all new pipework shall be cleaned with a material especially formulated to remove grease, oil, mill scale, and other foreign materials. Cleaner will be added to achieve an M.O. Alkalinity of 3,000 - 3,500 ppm and circulated for a minimum of 12 hours prior to flushing until analytical tests indicate removal of cleaner and foulants.
- B. Systems shall be operational, filled, started, and vented prior to cleaning.
- C. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

A. Concentration:

1. As recommended by chemical feed company.

B. Chilled, and Hot Water Systems:

1. Circulate for 48 hours, then drain systems as quickly as possible.
2. Refill with clean water, circulate for 24 hours, then drain.
3. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents on recommendation of system cleaner supplier.

D. Flush open systems with clean water for one hour minimum. Drain completely and refill.

E. Remove, clean, and replace strainer screens.

F. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 CLOSED SYSTEM TREATMENT

A. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION

SECTION 23 31 00 – DUCTWORK

PART 1 GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes permitted for job conditions. Size ducts installed in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.2 REFERENCES

- A. NFPA 90A - Installations of Air Conditioning and Ventilating Systems.
- B. SMACNA – HVAC Air Duct Leakage Test Manual.
- C. SMACNA – HVAC Duct Construction Standards – Metal and Flexible.
- D. SMACNA – Fibrous Glass Duct Construction Standards.
- E. UL 181 – Factory-Made Air Ducts and Connectors.

1.3 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 96 and SMACNA standards.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants or adhesives when temperatures are less than those recommended by manufacturer.
- B. Maintain temperatures during and after installation of duct sealants.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Provide the following information for each sealant system furnished on the Project:
 - a) Sealant name and type.
 - b) Sealant system design pressure.
 - c) Duct material.
 - d) Duct gage.
 - e) Transverse joint methods.
 - f) Longitudinal seam type.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: ASTM A623 and ASTM A623M galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.
- B. Stainless Steel: ASTM A480, Type 304, sheet form, with No. 1 finish.
- C. Uninsulated Flexible Ducts (Exhaust or Return):
 - 1. Manufacturers: Flexmaster Type NI35.
 - 2. UL-181, Class I: corrosion resistant galvanized steel helix permanently bonded to an impregnated, coated woven fiberglass cover.
 - 3. Pressure rating: 10" positive, 4" negative.

4. Maximum velocity: 5000 fpm.
5. Operating temperature: 0° to 200°F.

D. Insulated Low Pressure Flexible Ducts:

1. Manufacturer: Flexmaster Type 8M.
2. UL-181, Class I: coated, woven glass fiber mesh liner bonded permanently to corrosion resistant, galvanized steel helix, thick glass fiber insulation and low-perm vapor barriers of glass fiber reinforced metalized laminate with 3 plg standing seam and brass grommets.
3. Pressure rating: 4" positive, 2" negative.
4. Maximum Velocity: 3500 fpm.
5. Operating Temperature: 0° to 180°F
6. Thermal Conductance: .23 @ 75°F.

E. Insulated Medium Pressure Flexible Ducts:

1. Manufacturer: Flexmaster Type 4M.
2. UL-181, Class I: a heavy coated fiberglass cloth locked permanently to a galvanized steel helix, glass fiber insulation with fiberglass scrim on the outside; polyolefin vapor barrier jacket.
3. Pressure rating: 10" positive.
4. Maximum Velocity: 5000 fpm.
5. Operating Temperature: -20° to 200°F
6. Thermal Conductance: .23 @ 75°F.

F. Fasteners: Rivets, bolts, or sheet metal screws; stainless steel for stainless steel ductwork.

G. Sealants:

1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
2. Sealant shall be water based latex UL 181A-M, B-M reinforced sealant conforming to the product specifications.
3. Sealant shall be water based latex UL 181 B-M non-reinforced sealant conforming to the product specifications.
4. All ductwork in a UL classified rolled mastic duct sealant rated tape system shall be comprised of:
 - a) Rolled Mastic Sealant 2 mil foil faced with 15 mils of butyl adhesive/sealant conforming to the product specifications for UL classified sealants
 - b) Rolled Mastic Sealant 2 mil foil faced with 15 mils of modified butyl mastic/sealant meeting UL-181 BFX (pressure sensitive tapes for use with flexible air ducts) for UL listed sealants.

H. Hanger Rod: ASTM A36; steel, threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated. Unless noted otherwise, pressure class shall be determined by fan rating.
- B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two (2) gages heavier than duct gages indicated in SMACNA Standard. Prime coat welded joints with zinc-rich paint.
- E. Provide standard 45 degree lateral wye takeoffs or 90 degree conical tee connections.
- F. Uninsulated panels of ducts over 12 inches wide shall be cross-broken, except plenum casings, which shall be braced with angle iron as called for.
- G. All ductwork must present a smooth interior and joints must be air tight.
- H. Manual volume and splitter dampers to be furnished and installed where shown and where necessary for proper regulation of the air distribution. A quadrant and set screw equal to "Ventlock" #641 shall be installed for all dampers which are accessible.
- I. When the system is in operation, the ductwork shall be free from rattles and air noises caused by unsecure duct construction.
- J. All ductwork, low pressure supply, medium pressure supply, return, exhaust and outside air ductwork shall be constructed to meet SMACNA seal class A.
- K. Refer to section 3.3 for ductwork pressure class schedule.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated in paragraph 3.3.
- B. Round or oval ducts upstream of terminal units shall be prefabricated spiral lock seam conduit with fabricated fittings. All ells shall be 5-piece type. Take-offs shall be formed conical "T", or 45 degree "Y".
- C. Round Ducts:
 - 1. Manufacturers:
 - a) United Sheet Metal
 - b) Semco
 - c) Hamlin Sheet Metal
 - 2. Machine made from round spiral lockseam duct with reinforcing corrugations; fittings manufactured of at least two (2) gages heavier metal than duct.
- D. Transverse Duct Connection System:
 - 1. Manufacturers:
 - a) Duct Mate

2. SMACNA “E” rated rigid connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.

2.4 ACCESS DOORS

- A. All access doors shall close with air pressure. Small doors for access to dampers, etc., shall be 16” x 16” minimum. They need not be hinged, but shall be held in place with sash type locks. They shall have a flanged frame that overlaps liner or insulation.
- B. Ultra-low leakage doors. Nailor Model 0800 Type M1 Double Flange Frame for rectangular duct and Model 0895 for round duct, or equivalent. Knock-over tab frames are not permitted. Maximum leakage must not exceed British Standard DW144 Class A, B, and C.
- C. Provide a safety chain for doors accessed by ladder. Provide grab handles for doors 18" x 10" and larger when there is a positive pressure greater than 3 i.w.c.
- D. Provide long-life closed-cell gaskets.
- E. Provide access door at all locations requiring service access.

2.5 DUCT LINER

- A. “Nosing” sheet metal strip shall be installed on leading edge of all internal duct liner.
- B. See section 230700 Insulation for liner specification.

PART 3 EXECUTION

3.1 INSTALLATION - DUCTWORK

- A. Install in accordance with manufacturer’s instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. It is essential that all air ductwork be practically air tight. Before being insulated or concealed, all medium pressure air ducts and lab exhaust ducts, including the terminal connections, shall be tested for leakage. Each duct, under an air pressure test shall have no noticeable leaks. The total amount of leakage in the medium pressure supply ductwork of any system shall not exceed 1% of the total cfm of that system as measured by a manometer and a calibrated orifice. Test pressure for medium pressure systems shall be 6” WG.
- C. Duct sealant installation shall be in accordance with manufacturer’s published recommendations. Allow duct sealant system to cure minimum 48 hours before pressure testing for the fluid applied mastics. Rolled mastic sealants can be tested immediately. All low, medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual). Notify Owner minimum seven (7) calendar days in advance of leakage testing.
- D. Duct sizes on plans are inside clear dimensions
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Connect terminal units to supply ducts with maximum length of flexible duct as detailed on plans. Do not use flexible duct to change direction unless shown on drawings.

- I. Connect diffusers to low pressure ducts with maximum length of flexible duct as detailed on plans. Duct to be held in place with strap or clamp.
- J. Connect flexible ducts to metal ducts with adhesive and draw bands. Use sheet metal screws for positive pressure over 2".
- K. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- L. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.
- M. Manufactured casings shall be assembled and installed as noted in paragraph 3.1 A above.

3.2 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean duct in sections of size approved by the Designer. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean new plenums and accessible ducts in Mechanical/Equipment Rooms with high power vacuum machines. Clean existing plenums and accessible ducts in Mechanical/Equipment Rooms where indicated with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

3.3 DUCTWORK PRESSURE CLASS SCHEDULE

Air System	Pressure Class Inch
Low Pressure Supply (HVAC Systems and downstream of terminal units)	2
Medium Pressure Supply (upstream of terminal units)	6
Space Exhaust	2
All Other Ducts	2

END OF SECTION

SECTION 23 33 00 – DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers.
- C. Duct test holes.
- D. Flexible duct connections.
- E. Volume control dampers.

1.2 REFERENCES

- A. NFPA 90A - Installation of Air conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke Control Systems.
- C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service.
- E. UL 555 - Fire Dampers and Ceiling Dampers.
- F. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-Blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with push-pull operator strap. Provide air turning vanes in all supply and return square elbows. Vanes in medium pressure supply duct shall be double wall type.
- B. Steel or fiberglass fixed vanes for 90 deg. Elbows.

2.2 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.3 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA Medium Pressure Duct Construction Standards, and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz. per sq. yd., approximately 2 inches wide, crimped into metal edging strip.

2.4 VOLUME CONTROL DAMPERS

- A. Manufactures:
 - 1. Ruskin Manufacturing Co.

2. Arrow
 3. United Enertech
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
 - C. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and tow gages heavier for sizes over 24 inches.
 - D. Fabricate splitter of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
 - E. Fabricate single blade dampers for duct sizes to 12 x 48 inch.
 - F. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 122 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
 - G. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
 - H. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - I. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- C. Provide duct test holes where indicated and required for testing and balancing purposes. Neoprene plugs.
- D. Install automatic dampers in manner directed by Temperature Control Sub-Contractor.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 35 00 - TERMINAL HEAT TRANSFER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fan coil units

PART 2 - PRODUCTS

2.1 FAN COIL UNITS

- A. Manufacturer:
 - 1. Trane.
 - 2. Johnson Controls.
 - 3. Daikin.
 - 4. Envirotec.
 - 5. Price
- B. Unit shall include 18 galvanized steel chassis, coils, fan wheel, fan casing, fan board and motor. ABS plastic drain pan sloped in every plane and insulated with closed cell insulation. Steel parts exposed to moisture shall be galvanized. Unit shall be insulated with closed cell insulation. Provide a stainless-steel drain pan as alternate #4a.
- C. Horizontal Unit: All panels shall be fabricated from 18 gage galvanized steel. A duct collar shall be provided for connecting supply air duct to the unit.
- D. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, factory tested for 200 psi and 220 degrees F. Provide insulated drain pan under cooling coil, easily removable for cleaning, with drain connection. Heating coil shall be in reheat position. Provide stainless steel chilled water and hot water coil casing as alternate #4b. Provide 0.025" coil tube wall thickness as alternate #4c.
- E. Cabinet: 0.0598-inch (1.5 mm) steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, air outlet / inlet as shown in schedule. Provide tamper proof locks on access doors.
- F. Finish: Factory applied: clean, phosphatize and apply baked enamel of color as selected on visible surfaces of enclosure or cabinet.
- G. Fans: Centrifugal forward curved double width wheels, statically and dynamically balanced, direct driven as scheduled. Arrange for draw-thru airflow.
- H. Motor: Shall be brushless ECM motors with thermal overload protection. Motor controller shall be mounted in control box with a built-in user interface and tachometer. Adjustments can be made through momentary contact switches accessible on motor control board. Fan speed control shall be available with or without control interface and shall be unit mount. The speed control shall incorporate 0-10 Vdc signal providing limitless control of the motor RPM between factory set low and high speeds. The control box will include a line voltage to 24-volt transformer, ECM motor controller.
- I. Provide unit mounted disconnect switch.
- J. Filter: Easily removed 1-inch-thick glass fiber throw away type, MERV 8, located to filter air before coil. Provide 2" filters as alternate #4d.

- K. Piping package shall be provided that will include ball type shut off valves on the coil supply and returns with manual balancing valves, strainer, and unions. Controllers and control valves shall be furnished by controls contractor and fan coil unit manufacturer shall factory install. The package shall fit inside the unit casing and shall be accessible.
- L. Sound pressure level shall not exceed 30 dBA as measured 8' from return grille.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Duct Connection:
 - 1. Duct connections to unit to allow for straight and smooth airflow.
 - 2. Do not install duct turns at the fan discharge, which are in the opposite direction to a fan wheel rotation.
 - 3. Provide flexible connections at duct connections to unit.
- B. Piping Connections:
 - 1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.
 - 2. Install full size drain lines from the drain pan connection to permit condensate to drain freely.
 - 3. Route condensate drain piping to drain riser as indicated on plans. Mechanical Contractor shall ensure condensate pans are slope properly, 1/8" per foot, inside fan coil units for condensate to flow.
 - 4. Install service valves and companion flanges or unions on supply and return lines to coils.
 - 5. Coordinate with controls contractor for control valve to be installed with the pipe package provided with the unit to be installed inside the vertical stack unit. All the valves and controls inside the vertical stack unit must be installed in a manner they will be accessible for service from the return air access panel in front of the unit.

END OF SECTION

SECTION 23 36 00 - TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable volume supply reheat terminal units.
- B. Integral heating coils.
- C. Integral damper motor operators.
- D. Integral controls.

1.2 PERFORMANCE TOLERANCES

- A. Base performance on tests conducted in accordance with ADC 1062.

1.3 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Terminal units for spaces other than laboratory spaces:
 - 1. Price.
 - 2. Metal-Aire.
 - 3. Nailor Industries.
 - 4. Tuttle & Bailey.
 - 5. Environmental Technologies, Inc./Johnson Controls, Inc (ETI/JCI).

2.2 MANUFACTURED UNITS

- A. Variable air volume supply air control terminals for connection to single duct, central air systems, with electronic variable volume controls and hot water heating coils.
- B. Identify each terminal unit with clearly marked identification label and airflow indicator. Include unit nominal air flow, maximum factory set airflow, minimum factory set air flow, and coil type.

2.3 SINGLE DUCT VARIABLE VOLUME SUPPLY UNITS

- A. Basic Assembly:
 - 1. Casings: Minimum 22 gage galvanized steel.
 - 2. Lining: Minimum ½ inch thick foil-faced fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL 181 erosion requirements.

3. Plenum Air Inlets: Round stub connections for duct attachment.
4. Plenum Air Outlets: S slip and drive connections.
5. Heating Coils: Factory mounted and insulated.

B. Basic Unit:

1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 3 inches rated inlet static pressure.
3. Mount damper operator to position damper normally closed.

C. Hot Water Heating Coil:

1. Construction: 1/2-inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10380 kPa) pressure, factory installed.

D. Automatic Damper Operator:

1. Electric Actuator: 24-volt with high limit Velocity Reset Controller and Probe:
 - a. Electronic.
 - b. Minimum and maximum limits set at reset device.
 - c. Maintain air flow to within 5 percent of set point with inlet static pressure variations up to 2 inches.
 - d. Reset span, adjustable 3 to 8 psi (21-55 kPa) shall remain constant regardless of minimum or maximum setting. Reset start point shall be adjustable from 3-10 psi (21-69 kPa).
 - e. Provide terminal units with insulated access panel.

2.4 WIRING

- A. Factory mount and wire VAV terminal unit controls. Mount electrical components in terminal unit control box with removable cover.
- B. Provide industry standard 1/4" male spade connectors on terminal unit controller for field wiring of thermostat, communications and power source.
- C. All wiring shall comply with local and national electric codes and the manufacturer's published installation manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure. Do not support from adjacent ductwork.
- D. Connect to ductwork in accordance with Section 233100.
- E. Verify that electric power is available and of the correct characteristics.
- F. Provide for connections to electrical service. See electrical specifications.

3.2 TERMINAL UNITS

- A. The mechanical contractor shall install all airflow control devices in the ductwork and shall connect all airflow control valve linkages.
- B. The mechanical contractor shall provide and install insulation as required on coil casings, duct transitions, coil headers.

3.3 CLOSE OUT AND TRAINING

- A. The balancing contractor shall be responsible for final verification and reporting of all airflows.
- B. Instruct operating personnel in operation and maintenance of units.
- C. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided.

END OF SECTION

SECTION 23 52 34 - CONDENSING BOILERS

PART 1 GENERAL

1.1 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

1.2 DELIVERY, STORAGE, AND PROTECTION

- A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.3 REFERENCES

- A. AGA - Directory of Certified Appliances and Accessories.
- B. AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- C. ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.
- D. ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 54 (AGA Z223.1) - National Fuel Gas Code.
- G. NFPA 70 - National Electrical Code.
- H. UL - Gas and Oil Equipment Directory.

1.4 WARRANTY

- A. Provide a one-year warranty to cover parts and labor on all components of the boiler. Provide a five-year non-prorated warranty to include parts and labor coverage for heat exchangers, pressure vessels, and burner. The control panel shall have a two-year non-prorated parts and labor warranty. All warranties shall begin at initial start-up or six months after shipment whichever is first.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Aerco
- B. Fulton
- C. Lochinvar
- D. Patterson Kelly
- E. Weil McLain

2.2 MANUFACTURED UNITS

- A. Hot water condensing type boiler with gas burning system, controls, and boiler trim that are capable of operating in a single loop system that varies flow to the boiler. Boilers that require constant flow will be considered if the following conditions are met:
 - The boiler manufacturer shall supply all additional equipment and materials necessary to convert the system to a primary-secondary loop system. These components shall include but are not limited to pumps, temperature sensors, valves (manual and automatic), controls, and pipe.

- The controls must include an interface so that all additional sensing and control points will be made available for viewing and control from the energy management system provided under separate sections of this specification. The boiler manufacturer shall pay the EMS supplier directly for the changes that they must make to their system for both hardware and software modifications to incorporate the additional points into the EMS.
- The mechanical contractor must submit design changes via 1/4 scale drawings, diagrams and specifications that are necessary for the change to the engineer and owner for approval. The engineer and owner are under no obligation to accept designs that they deem detrimental to the operation and/or maintenance of the system. It is the boiler manufacturer's responsibility to show that the design proposed is beneficial to the owner. If the changes are accepted by both the engineer and the owner, the alternate design shall be provided as an AutoCad 14 DWG file to the engineer for incorporation into as-built drawings.
- The engineer and owner are under no obligation to accept any boiler that does not fully meet the above criteria.

2.3 CONSTRUCTION

- A. Boiler modules shall be natural gas fired, condensing fire tube design with a modulating forced draft power burner and positive pressure vent discharge. Boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.
- B. Modulating Air/Fuel Valve and Burner: The Boiler burner shall be capable of a 15 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall be nozzle mix design, with spark ignition and flame rectification. The burner head shall be cast stainless steel. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. The air and natural gas input shall be metered by a modulating air/fuel valve. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. Boiler manufacturers not capable of meeting the above, must show to the owner and engineer that their design has part load efficiencies equal to or greater than those that can be accomplished by utilizing the above method. They must also show equivalent or better ease of maintenance for their design.
- C. Air Intake System: The air intake system shall be the sealed combustion type and shall be made of materials recommended by the manufacturer and meet all local, state, and federal codes, regulations, and standards for that service.
- D. Boiler Safety Devices: Each boiler shall have an ASME approved relief valve with a setting as shown on drawings. Boiler gas valve shall only be opened after boiler safeties are verified to be clear and the forced draft system is in operation. when the exhaust A boiler flame monitoring system shall incorporate a UL recognized combustion safeguard system utilizing spark ignition and a rectification type flame sensor. An electro-hydraulic double seated safety shutoff valve with proof of closure switch shall be an inherent part of the gas train. Each boiler shall incorporate an electric type low water cutoff with test and manual reset and a dual over-temperature protection with manual reset in accordance with ASME Section IV and CSD-1 requirements. Remote fault alarm contact, sensor failure detection and boiler status and failure annunciator shall be standard equipment. Each boiler shall require an individual gas supply regulator, provided by the boiler manufacturer, for proper gas regulation at full load rated capacity.
- E. Pressure Vessel/Heat Exchanger: The boiler shall be capable of handling return water temperatures down to 40 F without any failure due to thermal shock or fireside condensation. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig. The pressure

vessel shall have a maximum water volume of 30 gallons. The boiler water pressure drop shall not exceed 4 psig at 180 gpm. The boiler water connections shall be 4" flanged 150 lb. ANSI rated. The pressure vessel is constructed of SA53 carbon steel, with a 0.25 in. thick wall and 0.50 in. thick upper head. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code.

- F. Control Panel: The boiler manufacturer shall supply as part of the boiler package a completely integrated boiler management system (BMS) controller to control all operation and energy input of the multiple boiler heating plant. The controller shall have the ability to vary the firing rate and energy input of each individual boiler through its full modulating range in order to maximize the condensing capability and thermal efficiency output of the entire heating plant. The BMS shall control outlet header temperature within +/- 2°F. The controller shall be PID type for accurate temperature control with excellent variable load response. The BMS controller shall provide contact closure for auxiliary equipment such as pumps and combustion inlet dampers based upon outdoor air temperature. Temperature control setpoints shall be adjustable from 50oF to 200oF in operation. When set on indoor/outdoor reset mode, the BMS will operate on an adjustable inverse ratio in response to the outdoor temperature to control the main header temperature. The BMS controller shall have an LCD display for monitoring of all sensors and interlocks. Non-volatile back-up of all control parameters shall be internally provided. The controller will automatically balance the sequence of operating time on each module by a first-on/first-off mode and provide for setback and remote alarm contacts. Connection between the BMS and the individual modules shall be twisted pair low voltage wiring, with boilers daisy chained for ease of installation. The panel shall be capable of controlling up to eight (8) boilers simultaneously. Provide a BACnet certified control module. All boiler system data shall be read remotely at the front end controls system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 54.
- C. Mechanical contractor shall obtain NC Department of Labor Inspection Certificate for each boiler and frame and mount adjacent to associated boiler.
- D. Install boiler on concrete base 4" deep and sized minimum 6 inches (150 mm) larger than boiler base.
- E. Provide connection of natural gas service in accordance with NFPA 54 and AGA Z223.1. Mechanical contractor is responsible for providing gas piping where indicated on plans (gas piping shall be in accordance with specification section 22 05 03).
- F. Provide for connection to electrical service. See electrical specifications.
- G. Each boiler on this job shall be through the wall vented as shown, utilizing positive pressure corrosion resistant vent. All aspects of installation and venting of the boiler plant shall be in strict accordance with the manufacturer's instructions. The vent system must conform to the manufacturer's recommendations and shall utilize a UL listed stainless steel AL-29-4C Positive Pressure Vent system, HeatFab Inc. or approved equal. Fabricate with 1 inch (25 mm) minimum air space between walls. Construct inner jacket of AL29-4C stainless steel suitable for condensing boilers. Construct outer jacket Type 430 stainless steel.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Instruct operating personnel in operation and maintenance of units.

3.3 TRAINING

- H. Manufacturer shall provide 4 hours of training on operation and maintenance of boilers for the Owner at the project site as coordinated as part of the project closeout.

END OF SECTION

SECTION 23 73 00 – MODULAR AIR HANDING UNITS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section of the work includes the design, fabrication, testing, cleaning and packaging, shipment and final assembly of air handling units by the unit manufacturer in complete accordance with the following specification.
- B. The details outlined, and component manufacturers named in this specification may not be deviated from in the air handling unit manufacturer's preparation of the bid, even where techniques are required which the manufacturer does not consider standard.

1.2 PRODUCT CLEANING, DELIVERY, STORAGE, AND HANDLING

- A. Thoroughly clean equipment, components and subassemblies of water, dirt, debris, weld splatter, grease, oil and other foreign matter prior to shipment.
- B. Seal and protect all openings in unit casings, housings and enclosures with thin gauge sheet metal closure sheets. Seal closures, caps and plugs dust-tight and moisture-tight.
- C. Protect pipe flanges with plywood coverings. Protect pipe threads with plastic end caps or plugs.
- D. Protect machined surfaces with suitable, easily removable rust preventive.
- E. Provide full charge of proper lubricant for grease lubricated bearings.
- F. Provide desiccant bags or vapor phase inhibitors where required to keep components dry.
- G. Units delivered with scratched, dented, or dirty surfaces or damage of any type shall be restored to "as new" condition as directed by the Architect/Engineer/Owner at no cost to Owner.
- H. If equipment is to be stored before use, the shipping protection provided by the unit manufacturer shall remain on the unit until the unit is installed. In addition, manufacturer shall submit written recommendations for field storage, both indoor and outdoor.
- I. Provide non-corrosive nameplate permanently attached to each piece of equipment containing the following information at a minimum:
 - 1. Manufacturer's project number
 - 2. Plant name and location
 - 3. Equipment number
 - 4. Date of manufacture

1.3 WARRANTY

- A. Manufacturer Warranty - Parts and labor for all equipment, materials and workmanship for a period of two (2) years from project acceptance.
- B. During the warranty period, the manufacturer shall repair or replace, at no additional cost to the Owner, any equipment, material, or workmanship in which defects may develop.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. York/JCI
- B. Trane

C. Carrier

2.2 GENERAL DESCRIPTION

- A. Fabricate air-handling units suitable for the scheduled capacities.
- B. Factory fabricate and test air handling units of sizes, capacities, and configuration as indicated and specified.
- C. Base performance on sea level conditions.
- D. All internal components specified in the air handling unit schedule shall be factory furnished and installed. Unit(s) shall be completely factory assembled.
- E. Units shall ship in one (1) piece whenever possible. A minimal number of shipping splits may be provided as required for installation. Lifting lugs will be supplied on each side of the split to facilitate rigging and joining of segments.

2.3 UNIT CASING

- A. The entire unit shall be provided with a full length, continuous, base rail channel. Base rail channels will be formed of a minimum of 12-gauge galvanized steel. The base channel shall have a minimum height of 4 inches. Units without a complete and continuous base rail (e. g. units with mounting legs) will not be acceptable. All segments shall be double wall and shall be constructed of G90 mill galvanized sheet steel, formed and reinforced to provide a rigid assembly. The exterior casing shall be constructed of minimum 18-gauge galvanized steel. The interior lining (except in unit discharge panel) shall be a solid lining of a minimum of 20-gauge galvanized steel. Floor panels shall be double wall with minimum 18-gauge galvanized steel, reinforced to support the weight of maintenance personnel. All panels shall be completely gasketed prior to shipment and shall be completely removable for unit access and removal of components.
- B. The interior lining within the cooling coil section shall be a solid lining of a minimum of 20-gauge stainless steel.
- C. Provide double wall construction with encased insulation between exterior and interior panels such that no insulation is exposed to airstream. Insulate casing sections with 2" thick 1.5 pound per cubic foot density insulation. The panel insulation must be a full 2" throughout the entire unit. Units with less than 2" of insulation in any part of the walls, floor, roof or drain pan, in any section (e.g. coil sections, mixing boxes, etc.) shall not be acceptable. In addition to panel insulation, insulate all structural channels connected to casing panels and cover openings in structural channels with galvanized steel. If structural channels are not internally insulated, then structural channels must be wrapped with an armaflex type insulation to maintain unit thermal performance and prevent sweating. Any portion of the unit that is not insulated (gaps) or has less than 2" of insulation shall be the responsibility of the contractor to modify.
- D. Double wall access doors shall be provided on sections as shown in control schematics. Doors shall be of the same thickness and construction as the wall panels. A gasket shall be provided around the entire door perimeter. Industrial style hinges shall permit a complete 180 degree door swing.

2.4 FANS

- A. Fan segments shall be equipped with direct drive single width single inlet (SWSI) housed fans or plenum (PL) fans as scheduled. Fans shall have airfoil (AF) blades as scheduled.
- B. All airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests made in accordance with AMCA standards 210 and comply with the requirements of the AMCA

certified ratings program for air and sound. In addition, all airfoil wheels shall comply with AMCA standard 99 2408 69 and 99 2401 82.

- C. After the pre balanced fan is installed in the air handler, the entire fan section shall be run balanced at the specified speed to insure smooth and trouble free operation. The run balance shall include filter-in and filter-out balancing in all three (3) planes, on both sides of the fan assembly at the bearings. Filter-in measurements shall be taken in the horizontal and vertical planes on the drive and opposite-drive sides of the fan shaft. Filter-out measurements shall be taken in the horizontal, vertical, and axial planes on the drive and opposite-drive sides of the fan shaft.
- D. Fan and fan motor shall be internally mounted and isolated on a full width isolator support channel using 1" static deflection springs. The fan discharge shall be connected to the fan cabinet using a flexible connection to insure vibration free operation.

2.5 BEARINGS AND DRIVES

- A. Fan bearings shall be self-aligning, pillow block, or flanged type regreaseable ball bearings, or rubber housed sealed bearings and shall be designed for an average life (L50) of at least 200,000 hours. All regreaseable bearings shall be factory lubricated and equipped with hydraulic grease fittings and lube lines extended to the motor side of the fan.
- B. All fans shall be direct drive..
- C. Fan shafts shall be selected to operate well below the first critical speed and each shaft shall be factory coated after assembly with an anti-corrosion coating.

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Fan motors shall be NEMA design ball bearing type with electrical characteristics and horsepower as specified on the schedule. Motors shall be 1750 RPM open drip proof type. All motors shall be high efficiency.
- B. The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.
- C. Service Lights: LED vaporproof luminaire with individual switched junction box located outside, adjacent to each access door and panel.
 - 1. Locations: Each section accessed with door or panel.

2.7 HEATING/COOLING COMPONENTS

- A. Cooling coil segments shall have a full width, sloped drain pan that extends downstream of the coil a minimum of 8" to contain moisture carryover. The unit design and coil selection shall not require a drain pan in any downstream section to contain the coil condensate. Drain pans shall be sloped in a minimum of 2 planes; cross break interior pans and pitch toward drain connections to ensure complete condensate drainage. Units with cooling coils shall have drain pans under complete cooling coil section. A minimum of 1" clearance shall be provided from the bottom of the coil casing to the drain pan so that the drain pan can be visually inspected and physically cleaned, including underneath coil, without removal of the coil. All drain pan connections will be to one side of the unit to enable proper trapping. Drain pans that do not comply with these maintenance requirements will be the responsibility of the contractor to field modify. The pan shall be of double wall construction with a stainless steel liner and shall be fully insulated. Drain pan shall be provided with a minimum 1-1/4" FPT condensate connection positioned beneath the lowest point of the drain pan.

- B. Coils with finned height greater than 48" shall have an intermediate drain pan extending the entire finned length of the coil. Cooling coils in excess of 48" in height shall not be acceptable unless provided with an intermediate drain pan. The intermediate pans shall have drop tubes to guide condensate to the main drain pan.
- C. All cooling and/or heating coils shall be furnished to meet the performance requirements set forth in the schedule. All water and steam coils shall have performance certified in accordance with ARI Standard 410. Coils used with glycol are outside the scope of ARI-410, but shall be selected to meet scheduled performance.
- D. All coils shall be slide out, "shipping" type, mounted on tracks and easily removable from the air handling unit by removing only one exterior panel. Coils that require additional disassembly of the unit or replacement of the entire coil section (e.g. "unit" type coils) for coil removal are unacceptable.
- E. Drainable Water coils shall be designed to operate at 250 psig design working pressure and up to 300°F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing. Coils shall be circuited for counter flow of air and water. Water velocities shall not exceed 7 feet per second and/or exceed the water pressure drops scheduled. All coils shall have same end connections regardless of the number of rows deep. Coils using turbulators are unacceptable. Units with staggered coil arrangements are unacceptable.
- F. Heating coil casing to be constructed of 16-gauge galvanized steel. Intermediate casing supports shall be supplied for finned lengths that exceed 60 inches.
- G. Cooling coil casing shall be constructed of a minimum of 20-gauge stainless steel. Intermediate casing supports shall be supplied for finned lengths that exceed 60 inches.
- H. The primary surface shall be 1/2" O.D. copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. The tubes shall have a minimum tube wall thickness of 0.016". Specified thickness shall be maintained throughout the tube including brazed U-bends. Coils manufactured with hairpin bends shall provide increased nominal wall thickness as required to compensate for the thinning of tube walls that occurs at the exterior of each bend.
- I. Extended surface shall consist of die-formed, continuous, aluminum fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface. The fin thickness shall be 0.006".
- J. Headers shall be of heavy seamless copper tubing, silver-brazed to tubes. Connections shall be of steel, with male pipe threads, silver-brazed to the headers. A 1/4" FPT, plugged, vent, or drain tap shall be provided on each connection. All vent and drain connections shall be factory extended to the outside of the unit casing.
- K. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

2.8 FILTERS

- A. Filters and filter segments shall be provided as scheduled. Filter frames shall be constructed of galvanized steel and be built as an integral part of the unit. Filter media shall be listed Class 2 or Class 1 under U.L. Standard 900 as required by local codes.
- B. Units shall be provided with Rigid Filter Segments designed to accommodate 2" pre-filters (All Units, 30%, MERV 8).

- C. Unit manufacturer shall provide three (3) sets of prefilter media with the unit for installation by others.

2.9 DAMPERS

- A. Dampers shall be of low leak design having stamped 16-gauge galvanized steel blades. The damper blades shall be provided with a PVC coated polyester fabric mechanically locked into the blade edge. The jamb is a flexible metal, compression type. Leakage will not exceed 7.20 CFM/square foot at 1" w.g. and 14.0 CFM/square foot at 4" w.g. The blades shall be parallel acting unless otherwise scheduled.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install each unit on a 4" channel base, grouted to set level.
- B. Mount each unit by spring isolators (minimum 1-1/2" deflection) to prevent transmission of vibration.
- C. Coordinate the selection of the isolators with manufacturer of the air handling units to assure compatibility of mounting details.
- D. Units with internal fame to utilize internal vibration isolation.
- E. Isolators for units mounted on inertia bases to be supplied by vibration isolation manufacturer.
- F. Provide clearance at each unit for routine service including the changing of filters, removal of coils, bearing greasing, opening of access doors, and pulling of blower shaft.
- G. Duct Connection:
 - 1. Duct connections to each unit to allow for straight and smooth airflow.
 - 2. Do not install duct turns at the fan discharge which are in the opposite direction to a fan wheel rotation.
 - 3. Provide flexible connections at duct connections to unit.
- H. Piping Connections:
 - 1. Support piping independently of coils and with adequate flexibility to prevent undue stress at coil header connections.
 - 2. Install full size drain lines from the drain pan connection and trap to permit condensate to drain freely.
 - 3. Route condensate drain piping to nearest floor drain.
 - 4. Install service valves and companion flanges or unions on supply and return lines to coils.
 - 5. Arrange piping such that valves can be shut off, a small section of pipe removed, and the coil pulled.

3.2 START-UP AND OWNER ORIENTATION:

- A. Replace prefilters when building is occupied with new prefilters.
- B. Equipment start-up and owner maintenance orientation shall be the responsibility of the unit manufacturer in order to activate equipment warranty and assure that the Owner and his facility personnel are comfortable and familiar with equipment maintenance.

- C. Manufacturer shall include a minimum of four hours on-site for owner maintenance training and orientation.
- D. The air handling unit manufacturer shall be responsible for proper operation and shall be required to meet the scheduled capacities and specified performance for this equipment.

END OF SECTION

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SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 REQUIREMENTS

- A. General Conditions of the Contract, Supplementary General Conditions, Instructions to Bidders, and General Requirements sections contained in the contract documents are a part of these Specifications.

1.2 EXTENT OF THE WORK

- A. This Contractor shall furnish all labor, materials, and equipment, and perform all operations necessary for installation of complete electrical work within the intent of, and as indicated on, the drawings and as herein specified.

1.3 REGULATIONS AND COMPLIANCE

- A. Latest editions of the National Electrical Code and the North Carolina State Building Code govern this work. All of their requirements shall be satisfied.
- B. Latest edition of North Carolina State Construction Office Electrical Guidelines.
- C. This Contractor shall secure and pay for all permits, fees, inspections, and licenses required. The electrical contractor shall notify the Office of the State Electrical Inspector at the State Construction Office (SCO) (authority having jurisdiction), to schedule required electrical inspections including, but not limited to, rough-in, above ceiling, and final inspections. Upon completion of the job he shall present to the Engineer a certificate of inspection and approval from the inspection authorities.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, with required Underwriter's Laboratories (or other agency approved by the State) label, and with manufacturer's label or nameplate giving complete electrical data.
- B. Where a manufacturer's catalog number is used, all parts shall be furnished to make it complete and to fit the construction intended.
- C. Within ten days after award, Contractor shall submit to Engineer a complete list in triplicate of all materials he proposes to use. List shall show a single manufacturer with not only major materials and equipment, but also such items as conduit fittings, raceway supports, conductive pipe thread compound, asphaltum, sealing material, clamps, anchors, outlet boxes, gutters, terminal cabinets, wire-pulling compound, splice connectors, tape, wire markers, lamps, etc.
- D. Material shall be the make and number given in these Specifications or shown on Drawings, or equivalent where specifically stated as being allowed. Equivalent items or materials will be subject to acceptance by the Engineer at submittal stage. If Contractor wishes to furnish a substitute for the item(s) specified (or equivalent where allowed), he shall furnish complete, detailed data and obtain approval of the substitution in writing from the Engineer no later than ten (10) days prior to bid. In some cases, at the request of the Engineer, samples of the substitute items shall be submitted for review. Data (and sample if required) shall be submitted in a timely manner such that approval by Engineer can be returned to Contractor no later than ten (10) days prior to bid date. Data or sample not submitted in sufficient time to allow evaluation by Engineer will be automatically rejected.
- E. Engineer's review of samples, cut sheets, shop drawings, and other matter submitted by the Contractor shall not relieve the Contractor of responsibility for full compliance with the Drawings

and Specifications. If a submitted item does not comply in any way (color, style, quality, function, or performance), Contractor shall call the specific non-compliance to the attention of the Engineer in writing in a cover letter to the submittals requesting a deviation from specifications. This does not imply that approval of requested deviation will be given, only that it will be reviewed.

- F. Engineer's review of submittals is not intended to confirm quantity counts of materials and equipment made by Contractor. Contractor is required to provide quantities of items as necessary for systems to function as described and shown on the plans and in these specifications.
- G. Specialty systems such as fire alarm systems, etc., that are included as part of the Electrical Contract shall be furnished and installed by an authorized representative of the manufacturer of the equipment supplied. This includes use of factory trained and authorized installers where required to fulfill manufacturer's warranty provisions.
- H. Submit cuts of fixtures, shop drawings on panels, and other descriptive materials requested, in six copies, or as required by the General Requirements section. Submittals will not be accepted or reviewed by the Engineer unless the electrical contractor's stamp signifying his review and approval is evident on the submittals.
- I. Materials should be inspected upon their arrival at the site to be sure they are correct. No extension of time for completion will be allowed because materials received are wrong. Completely adequate housing shall be provided on the site for orderly and careful storage of all materials and equipment. Nothing shall be stored outside except conduit, which may be stored in racks so it is at least twelve (12) inches above ground and not subject to mud being spattered on it.

2.2 PAINTING

- A. Suitable finish coatings shall be provided under this section of the Specifications on all items of electrical equipment and wiring which are exposed. This shall consist of either an approved factory applied finish or an acceptable finish applied during or after installation. Equipment which is furnished in finishes such as stainless steel or satin aluminum are not to be painted. Exposed equipment and/or wiring in finished areas such as panel covers or surface raceway shall be supplied with factory applied prime coat and shall be professionally painted or enameled as directed to result in a completely coated and attractively finished manner. All such finishing shall be as directed by and shall be satisfactory to the Architect and Engineer.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

- A. The electrical drawings are diagrammatic only and are intended to explain system function and define quality of materials and installation. They are not intended to define construction methods.
- B. Contractor shall keep on the site at all times one set of electrical drawings and specifications, and one set of drawings and specifications on the work of other trades. In addition, one complete set of all electrical submittals and shop drawings shall be maintained at the site by the electrical contractor.
- C. The electrician shall check other trades' drawings, specifications, and shop drawings to see if there are any conflicts or discrepancies. If so, he shall contact the Engineer for instructions.
- D. The Contractor shall properly protect his work against damage by weather or other trades. All work shall be left well cleaned, and damaged finishes shall be restored to original condition.
- E. The Contractor shall place his own sleeves and notify other trades of chases and openings far enough ahead so they can be properly built in. Where any raceways, supports, etc., installed under the contract pierce the roof, suitable pitch pockets shall be provided and coordinated with the

roofing contractor as necessary to be acceptable to the Engineer. Provide suitable fittings where any raceways or equipment cross expansion joints.

- F. This contractor shall be responsible for all trenching, backfilling, cutting, core drilling, and patching related to his work.
- G. Contractor shall provide firestops and smoke seals per Project Specifications and UL Details shown on drawings. All penetrations shall be sealed accordingly.
- H. Contractor should not scale drawings for outlet and equipment locations. Unless specifically dimensioned on drawings or defined in specifications, outlets and equipment shall be located as evidently intended or as detailed on Architectural drawings. Lighting outlets are to be centered or spaced symmetrically unless they are dimensioned. Any dimensions shown on the drawings shall be verified in the field by the contractor prior to roughing. All outlet and equipment locations shall be coordinated with the other trades. If any doubt arises, contact the Engineer prior to roughing.
- I. Contractor shall keep premises free of debris resulting from this work.

3.2 TESTS AND GUARANTEES

- A. All current-carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. Each fixture and item of equipment for connection under the Contract shall be tested for insulation resistance from its conductors to its grounded surface or contact. These tests shall be done with a 500 volt (minimum) high voltage "megger."
 - 1. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG and smaller wire, 250,000 ohms or more for #4 AWG and larger wire, between conductors and between conductor and the grounding conductor.
 - 2. After all fixtures, devices, and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure or ground bar. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel and until the low readings are found. The contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
 - 3. The Contractor shall send a letter to the engineer certifying that the above has been done and showing the tabulation of the megger readings for each panel or feeder. This shall be done at least four (4) days prior to final walk-through by engineer, and SCO.
 - 4. At final walk-through by the engineer and SCO, the contractor shall furnish a megger and demonstrate that the panels comply with the above requirements. He shall also furnish a clamp-on type ammeter and a voltmeter to take current and voltage readings as directed by the engineer, or SCO representatives.
- B. Validity of the ground path shall be assured by constant and careful attention to the thorough tightening of all couplings, connectors, locknuts, screws, bolts, etc., and by frequent checking of the path resistance with a quality low-range ohmmeter. Resistance of the path should not exceed one ohm between any two points. If a reading in excess of this is observed, it shall be discussed with the Engineer for an appraisal of the condition.
- C. Contractor shall guarantee that the work is done in accordance with drawings and specifications, and that it is free of imperfect materials or defective workmanship. Anything unsatisfactory shall be corrected immediately and at Contractor's expense.

- D. All test results for items A. and B. above shall be included in Operation and Maintenance manuals for Owner future trending.
- E. For the period of one year after acceptance by the Owner, the Contractor shall replace, without any expense to the Owner, any imperfect materials or defective workmanship.

3.3 RECORD DRAWINGS/MANUALS

- A. Upon completion of the installation, Contractor shall submit to the Engineer marked prints of Drawings showing any changes made in circuits, location of equipment, panelboards, or any other revision in the Contract Drawings, for the Owner's use in maintenance work and for future additions and expansions. Marked changes shall also include changes due to change orders unless already recorded by revised drawing or bulletin drawing.
- B. These record drawings shall be submitted in one of two formats: either a clean, legible, marked set of prints with all markings in distinguishable colored pencil such as red; or a set of reverse-run reproducible sepia prints marked in soft pencil so that blue-line prints can be reproduced as required. The format to be used shall be as defined in the General Requirements section of the contract documents. If no format is defined, the marked blue-line prints shall be submitted.
- C. Operation and Maintenance manuals shall be submitted to the Engineer at the end of the project prior to closeout of the project. Information included shall be a copy of all submittal data, shop drawings, and necessary operating and maintenance instructions and wiring diagrams on all major items of equipment and all special systems (fire alarm, intercom, etc.). Submit these manuals in the quantities and format described in the General Requirements Section.

END OF SECTION

SECTION 260519 – BUILDING ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 REQUIREMENTS

- A. All material shall be U.L. listed and shall be installed in conformance with the National Electrical Code.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactured by Southwire, Rome, or Triangle, of as otherwise noted in the specifications.
- B. Normal trade standard "building wire" of copper.
- C. Power and lighting circuits #10 AWG and smaller shall have solid copper conductors. Conductor sizes #8 AWG and larger shall have Class B stranded copper conductors. Maximum conductor size shall be 500 KCMIL.
- D. All sizes shall bear easily readable size and insulation grade marking along entire length.
- E. Insulation on #6 and smaller shall be suitably colored in manufacturing. Conductors #4 and larger may be identified with bands of proper color plastic tape near each termination and in each junction box.
- F. Insulation on service and feeders shall be 600 volt Type XHHW or THHN/THWN unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type.
- G. Branch circuits shall be a minimum of #12, with 600 volt THHN/THWN insulation unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type. Circuit wires carried through rows of fluorescent fixtures shall be at least Type THHN.
- H. Conductors in any location subject to temperatures higher than 60°C shall have insulation of a type approved by NEC for temperature encountered.
- I. Control and signal conductors shall be type and size indicated in those sections of the Specifications, or as specifically indicated on drawings.
- J. Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drop on both feeders and branch circuits combined to the farthest outlet shall not exceed five percent (5%). Where the conductor length from the panel to the first outlet on a 277V circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Where the conductor length from the panel to the first outlet on a 120 volt circuit exceeds 50 feet, the branch circuit conductors from panel to the first outlet shall not be smaller than #10 AWG. Where ungrounded conductors are increased in size from the minimum size that has sufficient ampacity for the intended installation, wire-type equipment grounding conductors shall be increased in size proportionately according to the circular mil area of the ungrounded conductor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring shall be color coded:

1. On 120/208 volt, 3 phase, 4 wire systems - phase A, black; phase B, red; phase C, blue; neutral, white. On 277/480 volt, 3 phase, 4 wire systems - phase A, brown; phase B, orange; phase C, yellow; neutral, natural gray. Ground conductor on all systems shall be green.
 2. Unless noted or accepted otherwise, busses in panels and switchgear shall be considered "A", "B", and "C" from left to right, top to bottom, or front to back when facing equipment.
 3. Control wiring shall not use black, red, or blue; but shall use white for neutrals and green for grounding. Any other colors may be used but the coding shall provide same color between any two terminals being joined.
 4. Switchlegs, including "travelers" in 3-way and 4-way switching systems, shall be same color as phase leg.
- B. Joints in #10 and smaller wire may be either made with approved twist-type connectors such as Ideal, Buchanan, T&B, Scotch, etc. "Stakon" or other permanent type crimp connectors shall not be used for branch circuit wiring.
- C. Joints in #8 and larger wire shall be made with approved Burndy, T&B, or O.Z. Manufacturing Co., mechanical pressure type connectors or lugs along with their UL approved insulating covers.
- D. Manufactured insulators for connectors may be used, provided they cover completely and securely all exposed metal. If joints and splices are taped, they shall be carefully covered with top-grade Okonite, Scotch Brand, or approved equivalent plastic or rubber and friction, laid on with half laps to result in a joint insulation equivalent to that of the conductor insulation.
- E. Circuit joints shall not be made on twin screws of convenience receptacles. Make joints as described above and run single leads to receptacle.
- F. All wiring lugs throughout the project, including, but not limited to, breakers, panelboard/switchboard lugs, safety switch lugs, and transformers lugs, shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310.15(B)(16).
- G. Wm. Brady Co., or approved equivalent, labels or the type made with a punch on plastic tape, giving the circuit number, shall be securely fastened to each branch circuit conductor within panelboards. They shall also be installed on all conductors within junction boxes, pull boxes, gutters, wireways, cabinets, or equipment where two or more wires of the same color occur.
- H. Where connected under screw or bolt heads, stranded wire shall be fitted with a lug of proper size. Make solid conductor loops clockwise so as to be forced closed as screw is tightened. Only one solid wire loop may be held under a single screw.
- I. Make all connections tight.
- J. Wires within panelboards, terminal cabinets, and similar equipment shall be neatly squared.
- K. Where paralleling of conductors is shown for feeders or service entrance, it is absolutely required they be exactly the same length between points of bonding together. Lay out side by side and cut to same length before drawing into raceways. Provide for each end of run a Burndy Q2A or W3A lug, or approved equal, and terminate parallels in these without cutting.
- L. Individual branch circuits shall not have shared neutrals.

END OF SECTION

SECTION 26 05 23 – CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Shall conform with Article 700 and 725 of NEC.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Shall also conform with the following unless noted otherwise on drawings or in other sections of these Specifications:
1. Conductors shall be run in metal conduit, unless specifically stated otherwise. These shall be complete with outlet boxes, junction boxes, fittings, etc., conforming in all respects with Section 260533.
 2. Conductors shall be #14 AWG minimum, stranded copper, and insulated with type THHN thermoplastic insulation rated for 600 volts unless noted otherwise in the specifications, specifically noted on the drawings, or Code requires another type.
 3. Conductors shall be colored in manufacture. Black, red, and blue shall be used only for connections of these wiring systems to proper phase in main wiring system. Color code throughout remainder of system shall be other colors selected by This Contractor, but same color shall be used between points of connection. In other words - do not change color at splices, in junction boxes, etc. White shall be reserved for neutral and green for grounding.
 4. In lieu of color coding, or in conjunction with, this Contractor shall identify each conductor using a label system, such as Brady labels, or equal. Each conductor shall be individually labeled with a distinctive number or number/letter combination at each termination point, including wire nut connections. A table shall be made identifying each conductor, its function, its origin, its final termination, etc. This table shall be typewritten and included in the final Operation and Maintenance Manuals and with a copy left in the main point of origin cabinet (such as fire alarm panel).
- B. Joints and connections shall be made as specified in Section 260519.

PART 3 EXECUTION

3.1 INSTALLATION

- A. This section is not used.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. All systems and equipment shall be grounded in accordance with NEC Article 250.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Manufactured by Thomas & Betts, Harger Lightning Protection, Lightning Master Corporation or approved equivalent.
- B. Bonding shall be done with #3800 series insulated bonding bushings and compression type lugs.
- C. Grounding conductor shall be THHN/THWN run in heavy wall conduit, and of size shown on drawings or required by NEC.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Any raceway anywhere in the system which enters a box or cabinet through part of a concentric or oversized knockout shall be fitted with an insulated bonding bushing and jumper. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards. The bonding jumper shall be sized by NEC Section 250 and lugged to the box.
- B. EMT couplings and connectors shall be compression-gland type of malleable steel, galvanized or sherardized. Connectors shall be insulated-throat type. Set screw, indentor, or cast type fittings are not acceptable.
- C. Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing, or in a threaded hub.
- D. The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per NEC Table 250.122, shall be run in ALL raceways except for telecommunications, data and audio conductors raceway.
- E. Ground all fixed and portable appliances and equipment connected under this Contract with a green grounding conductor. This wire shall be carried inside the raceway and flex from equipment to nearest grounded portion of raceway system. Connect at both ends with suitable lugs.
- F. All grounding type receptacles shall have a green wire jumper from their grounding terminal to box in which mounted. Attach jumper to box, not plaster ring, with a bolt or grounding clip. Jumper shall be sized by NEC with #12 minimum.
- G. Provide equipment grounding conductor from Owner provided grounding bar (as part of microscope installation package) back to main switchboard grounding bar.

END OF SECTION

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. All material shall be UL listed and shall be installed in conformance with the National Electrical Code.

1.2 SUBMITTALS

- A. Shop drawings for:
 - 1. Conduits
 - 2. Couplings and fittings
 - 3. Boxes
 - 4. Floor boxes
 - 5. Conduit seals
- B. Provide list of conduit types indicating where each type is used.

PART 2 PRODUCTS

2.1 RACEWAYS

- A. Manufactured by Allied Tube & Conduit, Wheatland, Western Tube & Conduit, or approved equivalent, or as otherwise noted in the specifications.
- B. Galvanized Steel Rigid Metal Conduit (RMC):
 - 1. Heavy wall tubing with hot dipped galvanized coating
 - 2. Connections shall be made with double locknuts and bushings. Bushings to be steel with integral insulator except conduits 2" and below may have high impact thermoplastic Phenolic insulating bushings.
- C. Intermediate Metal Conduit (IMC):
 - 1. Intermediate grade metallic tubing with hot dipped galvanized coating.
 - 2. Connections shall be made with double locknuts and bushings. Bushings to be steel with integral insulator except conduits 2" and below may have high impact thermoplastic Phenolic insulating bushings.
- D. Electrical Metallic Tubing (EMT) Conduit:
 - 1. Thin wall tubing with hot dipped galvanized coating.
 - 2. Couplings and connections shall be threaded steel, watertight gland compression type.
 - 3. All connectors shall have insulated throat.
- E. Rigid Nonmetallic Conduit:
 - 1. Heavy wall rigid, type 40, listed for underground encased and above ground applications.
 - 2. Heavy wall rigid, type 80, listed for underground encased and above ground applications.
- F. PVC Coated Conduit:
 - 1. RMC or IMC Conduit

2. 40 MIL PVC exterior coating
 3. 2 MIL Urethane coating on interior and treads
 4. Plastic tread protector caps
- G. Flexible Metal Conduit (FMC):
1. Electro-galvanized single strip steel.
- H. Liquid Tight Flexible Metal Conduit:
1. Electro-galvanized single strip steel with PVC coating.
- I. Stainless Steel Conduit:
1. Type 304 or 316
 2. Standard and special radius elbows
 3. Threaded couplings
- 2.2 BOXES
- A. Manufactured by Midland Ross/Steel City, T&B, Raco, or Appleton.
 - B. Galvanized or aluminum of gauge required by NEC.
 - C. All junction and pull boxes shall be 4 inch square by 2-1/8 inch deep minimum.
 - D. Stamped steel boxes with knockouts are not acceptable for surface mounting in finished spaces in the building.
 - E. PVC coated or stainless steel.
- 2.3 FASTENINGS AND SUPPORTS
- A. Shall be of good quality, galvanized steel or other non-corroding material.

PART 3 EXECUTION

3.1 RACEWAY INSTALLATION

- A. All wire and cable shall be run in raceway.
- B. Minimum raceway size shall be 3/4" (interior) and 1" (below grade) unless noted otherwise. Half inch flexible conduit may be used from junction box to above ceiling light fixtures (6' maximum length).
- C. All runs of empty conduit only shall have a 100# nylon pull rope installed in the conduit.
- D. Rigid metal conduit shall be made up with full threads to which T&B "Kopre-Shield" compound has been applied, and butted in couplings.
- E. Z. Split or "Erickson" couplings where necessary.
- F. No conduit shall be run in poured concrete floors or slabs. Conduit runs shall normally be run overhead. Where it is necessary to run underneath a concrete slab poured on-grade, conduit shall be buried in trench beneath gravel base and turned up through slab. Where it is necessary to run underneath a floor above a crawl space or another floor, conduit shall be run along ceiling space under floor and stubbed through floor using appropriate methods, such as "poke-through" devices or other means U.L. approved for such purpose.

- G. Underground runs, except under concrete floor slabs, shall be encased by a minimum of three (3) inches of concrete on all sides and shall have a minimum of eighteen (18) inch (non-roadway) and twenty-four (24) inch (roadway) cover, except for raceways containing circuits above 600V, which shall have a minimum cover of 30". Backfill shall be made in six (6) inch layers - tamping each layer to a density of 95% of maximum possible. Red dye shall be applied to the top of freshly placed concrete in all underground duct banks as a warning of electrical hazard in the event of future excavation. In addition, all underground raceway shall be identified by underground line marking tape located directly above the raceway at six (6) to eight (8) inches below finish grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compound for direct burial not less than 6" wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
- H. Where passing through a below grade wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equal to OZ/Gedney type "FSK" through wall fitting with "FSKA" membrane clamp adapter if required.
- I. Attach rigid metal conduits with double locknuts - one inside and one outside - and fiber bushing.
- J. Grounding type insulated bushings shall be used where raceway enters boxes with concentric or oversized knockouts. These bushings shall also be used wherever conduits stub into switchboards or transformer cabinets. Grounding type insulated bushings shall always be used on both ends of conduits feeding panelboards.
- K. Provide suitable fittings where raceway crosses building expansion joints.
- L. Securely fasten in place using approved strap or hanger within three (3) feet of each termination and not over ten feet apart in runs.
- M. Run concealed in finished areas unless otherwise noted.
- N. Make all cuts square with hacksaw. Remove any burrs or shoulders by reaming.
- O. All runs exposed and all runs above accessible ceilings shall be neat and square with building structure such as walls and ceiling/roof structures. Multiple parallel runs shall use trapeze supports where possible.
- P. "Flex" and "Sealtite" connections with T&B "Tite-Bite" and "Super-Tite" or approved equivalent fittings. Shall have insulated throats.
- Q. Where installing raceway on interior surface of exterior walls. Mount raceway 1/4" from wall with clamp-backs or strut.

3.2 APPLICATION

- A. Galvanized Steel Rigid Metal Conduit (RMC) Conduit required:
 - 1. Installations below grade (and in or under slabs where approved), except where specifically noted otherwise.
 - 2. Below 6 ft AFF in exposed areas of mechanical equipment rooms, except where specifically noted otherwise.
- B. Electrical Metallic Tubing (EMT) Conduit required:
 - 1. Interior panel feeders, except where specifically noted otherwise, etc.
 - 2. Interior partitions
 - 3. Above suspended ceilings

4. Above 6 ft AFF in exposed areas of mechanical equipment rooms, except where specifically noted otherwise.
 5. Sizes 2" and smaller except as approved, except where specifically noted otherwise.
 6. EMT conduit, couplings, elbows, and fittings shall **not** be installed:
 - a) Any location outdoors, in direct contact with earth, or underground (in/below slab-on grade or in earth)
 - b) Indoors in wet or damp locations, or in concrete, cinderblocks or bricks
 - c) Where exposed to severe corrosive influence and/or severe physical damage
 - d) Encased in concrete
 - e) For transition between EMT and rigid conduits, use junction box.
- C. Nonmetallic Rigid Conduit required:
1. Direct burial, concrete encased.
 2. Direct burial, in sand fill on bottom and top.
- D. Liquid Tight Flexible Metal Conduit required, not over 4 ft in length, for final connections to:
1. Equipment in wet locations.
 2. Equipment with vibration isolation mounting.
 3. Equipment housing ferromagnetic cores or with integral moving components, capable of generating noise or vibrations including transformers and motors.
 4. Pumps and associated equipment.
 5. Instruments and control devices.
 6. All flexible connections to equipment in fire pump room below 60" AFF.
- E. Flexible Metal Conduit required, not over 4 ft in length, for final connections to:
1. Equipment in dry locations.
 2. Equipment in dry locations with vibration isolation mounting.
- F. PVC Coated Conduit shall be used:
1. In corrosive atmospheres where specifically noted on plans.
 2. In exterior environments needing additional protection where specifically noted on plans.
- G. Stainless Steel Conduit shall be used for:
1. Exposed conduits in GMP Clean Room or Wash Down environments.
- H. Aluminum Surface Mounted Raceway (Labs)
1. Surface mounted in labs with receptacles, data outlets as required per the drawings.
 2. Provide with all necessary components for complete professionally installed system including, but not limited to, base, cover, clips, elbows, couplings, seam clips, entrance fittings, device plates, devices, etc.

3.3 BOX INSTALLATION

- A. Attach EMT with connector only.
- B. Outlet boxes shall be sized in accord with NEC Section 314. All lighting outlet boxes shall have fixture studs. Device boxes shall be sectional type or 4" square equipped with plaster rings as required to mount the device. Set edge flush with finished surface. Boxes may be installed at top or bottom of a masonry course. Raco, or approved equivalent, masonry boxes in sawed block. 1-1/4" and deeper plaster rings may be of die-cast aluminum of Steel City make, or approved equivalent.
- C. Where installed in metal stud partitions, wall boxes shall be supported from two adjacent studs using a system such as Caddy Bar Hanger Assembly, or approved equivalent. Support on a single stud is not acceptable.
- D. Fixtures weighing more than six pounds shall be supported from the fixture stud.
- E. Where not shown differently on the drawings, mount:
 - 1. Switch boxes 46" from finished floor to center. Boxes beside doors shall be mounted so edge of trim plate is 2" from edge of door trim on strike side.
 - 2. Telephone boxes 18" from finished floor to center and vertical. Boxes for wall phones shall be 46" from finished floor and vertical.
 - 3. Bracket light boxes as indicated on plans or as directed by Engineer.
 - 4. Clock outlet boxes 7'-0" from finished floor, or 6" below finished ceiling, to center.
 - 5. Panel cans 6'-4" (± 4 " in concrete block construction) from finished floor to top of can.
 - 6. Fire alarm pull stations 46" from finished floor to center.
 - 7. Fire alarm chimes, horns, strobes, etc., 80" above finished floor or 6" below finished ceiling, whichever is lower, and shall comply with ADA requirements.
- F. Where not shown differently on the drawings, mount boxes for receptacles to receive device in a vertical position and be:
 - 1. Centered 18" above finished floor.
 - 2. Centered 6" above counters, shelves, or cabinets where apparently intended to be so placed.
 - 3. Centered 4" above high edge of backsplashes.
 - 4. Where devices are to be ganged, provide boxes to receive devices trimmed with a gang plate.
- G. As soon as installed, all raceway openings shall be closed with plastic inserts to prevent entrance of foreign matter during construction. All enclosures shall be kept clean of any foreign matter. Install Jordan "Kover-All" plastic covers over outlet boxes ahead of plastering or painting.
- H. Conduit(s) from all boxes installed on exterior walls or in areas going from conditioned to unconditioned space shall have conduit(s) sealed with duct seal or equivalent to prevent moisture formation. Duct seal or equivalent shall also be installed in all raceways entering from exterior of building.

3.4 FASTENINGS AND SUPPORTS INSTALLATION

- A. Inserts in masonry shall be lead, fiber, or plastic types installed in drilled holes. Wooden plugs shall not be used. Lead only shall be used on all exterior masonry or interior masonry subject to permanent moisture. Hung raceways shall be supported from the structure with rod supports at least 5/16" in diameter.

- B. All equipment and flat raceways attached to outside wall or interior walls subject to permanent moisture shall be shimmed out with non-corrodible material so as to provide 1/4" air space between wall and equipment or raceway.
- C. All materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher.
- D. All fixtures, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceilings, including the hanger wires, unless definitely noted so on the drawings or specifically permitted by the Engineer.
- E. Recessed fixtures shall be supported at the two (2) opposite ends to the structure. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the fixture and the other end to the building's structural system. Lay-in fixtures shall also be screwed to the main runners of the lay-in ceiling track at all four corners using sheet metal screws.
- F. Recessed ceiling speakers, where specified with an enclosure, shall have the enclosure supported directly from the structure with a minimum of two 10 gauge wires run perpendicular to the ceiling and not pulling to one side. If recessed ceiling speaker is specified without an enclosure and is mounted in a suspended ceiling, the speaker shall be supported using T-Bar bridges such as Soundolier No. 81-8, or other device specifically designed for such support. In addition, each of the four corners of the ceiling grid block enclosing the speaker shall be supported from the structure using 10 gauge steel wire run perpendicular to the ceiling plane.
- G. Other devices using octagonal or 4" square ceiling boxes, such as smoke detectors, dome lights, exit signs, etc., where installed in suspended ceilings shall be supported from the ceiling system using Caddy, or other, hangers specifically designed for such support. In addition, each of the four corners of the grid block enclosing the box shall be supported from the structure using 10 gauge steel wires run perpendicular to the ceiling plane.
- H. Support for pipe straps or clamps shall be toggle bolts on hollow masonry; metal expansion shields and machine screws, or standard pre-set inserts, on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction. The resulting fastening shall be completely secure.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 NAMEPLATES

- A. Furnish and install engraved laminated phenolic nameplates for all safety switches, panelboards, transformers, switchboards, motor control centers, and other electrical equipment supplied for the project for the following: identification of equipment controlled or served, phase, voltage, panel and circuit(s) feeding equipment.

Example:

1A

120/240V, 1Ø, 3W

MDP-1,2

- B. Furnish and install permanently mounted label on each device plate for receptacles indicating its panelboard and circuit number. Labels shall be made using electronic labeling system with black letters on clear background. Write-on labels are prohibited.

PART 2 PRODUCTS

2.1 NAMEPLATE MATERIALS

- A. Nameplate material colors shall be (conforms with State Construction Office requirements):
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. Brown surface with white core for all equipment related to data systems.
 5. Green surface with white core for all equipment related to emergency system.
- B. All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by phenolic tags with wire attached to conduit or outlet.
- C. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match color scheme outlined above. This includes covers on boxes above all type ceilings.

PART 3 EXECUTION

3.1 NAMEPLATE INSTALLATION

- A. Nameplates shall be securely attached to equipment with self-tapping stainless steel screws, if sharp end is protected; otherwise, rivets shall be used. Nameplates shall identify equipment controlled, attached, etc. Letters shall be ½" high minimum for panel identification. Letters for other information shall be ¼" high minimum. Embossed, self-adhesive plastic tape is NOT acceptable for marking equipment.

END OF SECTION

SECTION 26 05 93 – ELECTRICAL SYSTEMS FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCE

- A. The work under this section is subject to the Contract Documents including General Conditions, Supplementary Conditions, and under Division 1 – General Requirements.

1.2 SCOPE

- A. Furnish and install work under this section including, but not limited, to the following:
 - 1. Penetrations through fire-resistance-rated floor, roof, walls and partitions including openings containing conduits, cables, cable bundles, cable tray and other penetrating items.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Firestopping systems shall be UL Classified for the application and correspond to those indicated by reference to designations listed by UL Fire Resistance Directory.
- B. Firestopping systems and installation shall meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable code authority having local jurisdiction.

1.4 SUBMITTALS

- A. Manufacturer's specifications and technical data for each material including composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Material safety data sheets provided with product delivered to job-site.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design and intent to that indicated for Project and that has performed successfully.
- B. A manufacturer's direct representative to be on-site during initial installation firestop systems to train appropriate contractor personnel in proper selection and installation procedures.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product, type and UL label where applicable.
- B. Store materials to prevent deterioration or damage due to moisture, temperature changes, contaminants or other causes.
- C. Handle with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

1.7 PROJECT CONDITIONS

- A. Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturer or when substrates are wet due to rain, frost, condensation or other causes.
- B. Ventilate firestopping per manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.8 SEQUENCING AND SCHEDULING

- A. Do not cover up those fire stopping installations that will become concealed behind other construction until authorities having jurisdiction, if required, have examined each installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. 3M, Hilti, Tremco, Nelson Firestop Products, Specified Technologies, Inc, or Rectorseal Corp.

2.2 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.
- B. Materials shall not contain flammable solvents.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, for compliance with requirements for opening configurations, penetrating items and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean out openings immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer.
- B. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- C. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Comply with "System Performance Requirements" article in Part 1 and manufacturer's installation instructions and drawings.
- B. Install forming/backing materials and other accessories of types required to support fill materials during application as required. After installing fill materials, remove forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Avoid multiple penetrations of common fire barrier opening. When possible, seal each penetration in accordance with project details. When multiple penetrations are unavoidable, seal openings with appropriate UL Classified firestopping systems.

3.4 FIELD QUALITY CONTROL

- A. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- B. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.5 CLEANING

- A. Clean surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 26 24 16 – PANELBOARDS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Equipment shall be built to NEMA Standards where such standards exist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Eaton panelboards are specified for Hunt Hall and GE panelboards are specified for Reynolds as a basis for design. Equivalents by Cutler-Hammer or Square D may also be quoted.
- B. Types, sizes, capacities and characteristics shall be as shown on riser diagram or in schedules. Service equipment shall be labeled "UL Approved for Service Entrance Use".
- C. Branch circuit panelboards shall be bolt-on type, Square D NQOD or NF types, or equivalent. Distribution panelboards shall be Square D I-Line types HCN, HCM, HCW, as indicated on plans, or equivalent.
- D. All breakers shall be fully rated. Series rating are not acceptable.
- E. Feed through panels shall not be used.

2.2 CONSTRUCTION FEATURES

- A. Housing shall be constructed of Code gauge galvanized sheet steel and shall be securely fabricated with screws, bolts, rivets or by welding. Housings for branch circuit panelboards shall be 20" wide and 5-3/4" deep. Housings for distribution panelboards shall be no larger than the panelboard specified as shown on the plans or the Contractor shall verify larger panelboard will fit and still maintain the proper Code clearances because space is at a premium.
- B. Top or bottom gutter space shall be increased six inches where feeder loops through panel. End plates shall be galvanized Code gauge (minimum) and shall be supplied without knockouts.
- C. Covers shall be constructed of high grade flat sheet steel of Code gauge minimum with the following:
1. Door flush with face and closed against a full inside trim stop. Hinges shall be inside type.
 2. A combination flush latch and Yale, Corbin or equivalent, tumbler-type lock, so panel door may be held closed without being locked. All such locks on same job shall be keyed alike. Plastic lock type trims are not acceptable.
 3. Finish of manufacturer's standard color of top-grade enamel over a phosphatized or other approved rust inhibitor treatment and prime coat, or as specified in Section 260500.
 4. Four or more cover fasteners of a type which will permit mounting plumb on box. Cover shall also have inside support studs to rest on lower edge of can while being fastened.
- D. A means of readily adjusting projection of panel interior assembly with all connections in place shall be provided. A method requiring stacking of washers is not acceptable.
- E. Interior trim shall fit neatly between interior assembly and cover - leaving no gaps between the two.
- F. Circuit breakers:
1. Circuit breakers shall be by the same manufacturer as the panel in which mounted unless specifically stated otherwise on the plans.

2. Breakers shall be equipped with specific accessories, such as shunt trip, handle lock, etc., as indicated on plans.
 3. Individual breakers shall be securely and tightly mounted on their supporting structure so they do not depend upon the current-carrying bus for support, unless a combination support/bus is considered adequately strong by the Engineer.
 4. Breakers in lighting and branch circuit panels shall be "Quicklag" type bolted to the supply bus. Plug-in types are not acceptable.
 5. Breakers in distribution panels shall be molded-case thermal-magnetic type unless specifically indicated otherwise on plans. Multi-pole breakers shall have common tripping of all poles.
 6. Breakers shall have factory installed mechanical type lugs to accept solid or stranded type conductors and shall be rated for use with wire rated at 75 degrees C.
 7. All molded-case circuit breakers shall be labeled as meeting U.L. 489.
 8. Circuit breakers 400A and greater shall be electronic trip type, molded case, individually mounted breakers, listed under U.L. 489. Breakers shall be 80% rated (unless noted as 100% rated in schedule) with field interchangeable rating plugs as stated on the drawings. U.L. listed interrupting rating shall be the same as for the main breaker.
- G. Supply lugs shall be installed on busses and neutral bar so they may be readily and securely tightened from the front with panel in place and wired. A suitable arrangement shall limit their movement out of plumb. It shall not be possible to move the lugs so that metal parts between phases are closer than 3/8".
- H. All panels shall have 100% rated copper busses and neutral bar, with substantial connections where breakers bolt to busses.
- I. All wiring lugs in panelboards and all breakers shall be rated for use with 75 degree conductors sized in accordance with NEC Table 310.16 (2020 NEC).
- J. All branch circuit panels shall be equipped with 100% rated copper ground busses.
- K. Breakers in lighting or branch circuit power panelboards shall be physically arranged in locations shown in panel schedules and be connected to the phases shown. Any deviation shall be approved by the engineer in advance. Panelboards shall be equipped with directory cards mounted behind heavy clear plastic shields in substantial frames attached to inside face of doors. Cards shall be a minimum of three inches wide.
- L. Panelboard manufacturer shall determine the flash protection boundary and the incident energy for the electrical equipment in accordance with IEEE 1584 and NFPA 70E requirements and shall provide labels for each panel with the required information accordingly.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Flush-mounted panel housings shall be flush with finished wall.
- B. Mount equipment plumb and level.
- C. Openings in boxes, cabinets, or gutters shall be cut or sawed. Burning of openings is prohibited.
- D. Each lighting or branch circuit panelboard mounted flush in a wall shall have a minimum of five empty 3/4" conduits stubbed out into the ceiling space above panel for future use unless all circuits in a panel are assigned. Seal ends of conduit with caps or with UL approved fire stopping material.

- E. Only one solid wire is allowable under a screw. Use lug for connecting stranded wire or more than one solid conductor.
- F. Label all equipment in conformance with Section 260553.
- G. Panelboard directory card shall be neatly typed with circuits assigned as shown on schedules. Space typing on card so all is visible when inserted into frame. Use room names and numbers as provided by Owner, not those shown on schedule. Names and numbers on schedule relate to plans only for construction. Indicate spare breakers in pencil (not typed) so that owner can erase and change as necessary in the future.
- H. Next to each breaker within main or distribution panelboards, attach a label indicating what it feeds. Wording shall be as shown on its diagram or schedule. Labeling shall also be attached to separately-mounted breakers, switches, transformers, wiring gutters and controllers of all types.
- I. Centered above door on panel cover attach a label indicating panel designation - for example, "PANEL A"; voltage - "120/208 VOLTS"; and from where served - "FED FROM PANEL MDP". See Section 260553 for details.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 GENERAL

1.1 WIRING METHOD FOR BRANCH CIRCUITS

- A. Outlets in the same general area are circuited together. Circuit numbers are shown as noted in symbol schedule.
- B. Unless shown differently, 120 or 277 volt branch circuits on single or three phase systems shall be limited to three phase conductors per raceway. Three phase circuits shall be limited to one circuit per raceway (three different phase wires and neutral(s) if needed). In addition, each conduit shall contain one equipment grounding conductor.
- C. Individual neutral wires shall be provided for each circuit (no sharing of neutrals between circuits).
- D. The neutral carrying all or any part of the current of any specific load or run shall be contained in the same raceway or enclosure with the phase wire or wires also carrying that current. No split neutrals permitted.
- E. Circuits shall be connected to panels as shown in the panel schedule. Any deviation shall be approved in advance by the engineer.
- F. Under the above requirements and with required color coding system no feeder or branch circuit raceway will contain more than one wire of the same color, except for switch legs and control circuits.
- G. Conductors feeding lighting outlets may be combined in the same raceway with conductors feeding convenience receptacles; but lighting outlets and convenience receptacles shall not be put on the same circuit unless specifically indicated.
- H. Toggle switches shall be single pole, three-way, or four-way as indicated on drawings. Switches shall be of grounding type, with hex-head grounding screw, rated 20A, 120/277V, AC only. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be listed by an “approved” third party agency, approved for the voltage and amperage indicated.
- I. Duplex receptacles shall be of the grounding type, arranged for back and side wiring, with separate single and double grounding terminals. Receptacles shall be straight blade, rated 20A, 125V and the face configuration shall conform to the NEMA Standard WD-1, NEMA WD-6, DSCC W-C-596G and UL-498, and shall be “approved” third party listed. Self-grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a direct, green insulated conductor connection to the equipment grounding system.
- J. Receptacles shall be industrial specification grade or heavy duty grade, mounted vertically. Receptacles mounted over counters, back-splashes and where specifically noted otherwise shall be mounted horizontally.
- K. Receptacles shall not be mounted back to back.

PART 2 PRODUCTS

2.1 WIRING DEVICES

- A. Switches considered equivalent are as follows:
 - 1. Single Pole:
 - a) Hubbell 1221
 - b) Bryant 4901

- c) P & S 20AC1
- d) Leviton 1221
- e) Eagle 2221

B. Duplex receptacles considered equivalent are as follows:

- 1. Heavy Duty Specification Grade:
 - a) Hubbell 5362
 - b) Bryant 5362
 - c) P & S 5362
 - d) Leviton 5362
- C. The color of all devices shall be white (subject to verification with Architect during submittal stage). Samples will be required prior to acceptance of any proposed equivalents not specifically mentioned above. All like devices shall be by the same manufacturer (i.e.; all switches, all duplex receptacles, etc.).
- D. Unless noted or specified otherwise, device trim plates shall be type 302 stainless steel to suit device. All plates in the job shall be same make and match throughout.
- E. Ground fault interrupter type duplex receptacles shall be heavy duty specification grade. Where used outdoors, they shall be the weather-resistant type, as well as ground fault unless otherwise indicated. They shall have metallic extra duty rated weather proof while-in-use protective covers (Hubbell WP26E/WP26EH series or equivalent).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Devices shall be mounted tightly to boxes and be adjusted plumb and level.
- B. Receptacles are to be installed in the vertical position with the ground terminal on top.
- C. Two or more devices ganged shall be trimmed with gang plate.

END OF SECTION

SECTION 26 29 00 – MOTORS, CONTROLLERS, AND EQUIPMENT CONNECTIONS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Motors, controllers, and other special equipment are sometimes provided and installed by other trades. This section specifies typical connections to that equipment.
- B. All individual motor starters or VFD's for plumbing & mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Divisions 22 & 23 (Plumbing & Mechanical Contractors) unless indicated as a part of a motor control center. Motor starters for mechanical equipment provided in motor control centers shall be furnished under Division 26 (Electrical Contractor). Under Division 26, power wiring shall be provided up to a termination point consisting of a junction box, trough, starter, VFD or disconnect switch. Under Division 26 line side terminations shall be provided. Wiring from the termination point to the plumbing or mechanical equipment, including final connections shall be provided under Divisions 22 & 23.
- C. Where electrical wiring is required by trades other than covered by Division 26, the installer shall refer to the wiring materials and methods as specified under Division 26.

PART 2 PRODUCTS

2.1 EXHAUST FANS

- A. Exhaust fans are indicated by special symbol on plans. Unless otherwise noted, they will be furnished and set by others and connected by the Mechanical Contractor. Controller will be provided by others unless controller is specified on electrical drawings. Electrical contractor shall provide a local disconnect switch at fan if unit is not provided with one. Where indicated as controlled from several double pole switches, the second pole of each switch shall be connected in parallel so fan will run when any one or more of the switches is on.

2.2 UNIT HEATERS

- A. Unit heater, ventilator, cooler, or similar outlets - designated by special symbol - are located approximately on drawings. Exact location of outlet shall be obtained from Heating, Ventilating, and Air Conditioning Contractor. Unless indicated otherwise, outlet shall be a 4" box fitted with an oversized blank cover with 1/2" center knockout, mounted in wall or ceiling, and fed on circuit shown beside symbol. These outlets shall be located behind or within equipment cabinets where possible and still be accessible. Provide local disconnect switch if one is not provided with unit. Unless specified otherwise herein or on drawings, power connection from outlet to equipment will be by Mechanical Contractor. Control wiring will be done by the Mechanical Contractor.

2.3 TROUGHS

- A. Electrical troughs, junction boxes, switches, or breakers for air conditioning, heating, or plumbing equipment are indicated on drawings. Exact locations shall be obtained from Heating and Air Conditioning or Plumbing Contractors but Code clearances shall be maintained. Unless specifically noted otherwise, all power wiring for equipment and controllers beyond these points will be done by Heating and Air Conditioning or Plumbing Contractors. Control wiring will be by Heating and Air Conditioning or Plumbing Contractors.

2.4 OTHER

- A. Other equipment connections are generally indicated on drawings by a circled black triangle with a letter suffix. These are then defined in notes or details. Where catalog numbers, models, or types, and manufacturer's name are given, these items of equipment shall be furnished and installed by the Electrical Contractor, unless specifically noted otherwise.

- B. Junction box - designated as a circled J. Size of such boxes is generally noted on drawings. Where this is not done, they shall be sized in accord with NEC and purpose evidently intended.
- C. Where unscheduled junction boxes are used by Contractor to facilitate wiring or to comply with limits of elbows and bends, they shall be concealed if at all possible to do so and still be left accessible. If this is impossible, they shall be recessed in walls or ceilings and provided with an oversized cover which shall be painted out to match adjacent surfaces. If it is necessary to mount such boxes exposed, the location shall be approved by the Engineer.
- D. All contactors, motor starters and combination type starters specified under this contract shall be equipped with Hand-Off-Automatic switches, pilot (run indicating) light, 120 volt control transformer, and two sets of auxiliary contacts. The switch and light shall be located on the unit cover. Starters shall be Square D, Cutler-Hammer, General Electric Co., or equivalent by others.
- E. All safety switches shall be heavy-duty type, NEMA 1 for indoor and NEMA 3R for outdoor use unless specifically stated otherwise. They shall be fused type unless specifically indicated otherwise on plans. Fused type (600 volts or less) shall be equipped with the following: Service Entrance and Feeder Circuits over 600A – Class L, UL Listed, current limiting with 200K interrupting rating; Service Entrance and Feeder Circuits 600A and less – Class RK1 or J, UL Listed, current limiting with 200K interrupting rating; Motor, Motor Controller and Transformer Circuits – Class RK5, UL Listed, current limiting time delay with 200K interrupting rating; and individual Equipment where fault current does not exceed 50kA – Class K5, UL Listed, with 50K interrupting rating. Fusible safety switches with short circuit withstand rating of 100K or 200K shall include Class R or Class J rejection fuse block feature. Switches shall be equipped with defeatable door interlocks and padlocking provisions in the on and off positions. Padlocks shall be provided for switches located in public areas. Switches shall be by Square D, Cutler-Hammer, General Electric Co., or equivalent by others. In addition, safety switches shall be provided with the following requirements or features:
 - 1. Safety switches shall be third party listed.
 - 2. Switches shall have door interlocks that prevent the door from opening when the operating handle is in the “on” position.
 - 3. Switches shall have handles whose positions are easily recognizable in the “on” or “off” position. For safety reasons, padlock shall be provided for switches unless they are located in a locked electrical room.
 - 4. Switches shall have positive quick make-quick break mechanisms.
 - 5. Switches shall be properly labeled. Refer to Specification 260553.
 - 6. The Electrical contractor is to provide to the Owner as spares, 10% of the quantity of fuses used of each type and rating, with a minimum of one (1) set of each type.
- F. All safety switches, motor starters, or other boxes or panels, designated as NEMA 3R or otherwise intended for outdoor use or use in wet areas, shall use raintight conduit hub fittings with bonding screw.
- G. Control wiring shall not be installed in the same raceways as power wiring.

PART 3 EXECUTION

THIS SECTION NOT USED

END OF SECTION

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY SPECIFICATIONS
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<u>SECTION</u>	<u>TITLE</u>
28 31 00	FIRE DETECTION AND ALARM



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SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 REQUIREMENTS

- A. This Contractor shall furnish and install equipment to the existing fire alarm system as indicated on drawings and as specified herein for a complete and functional system. The system shall be electrically supervised with intelligent analog alarm initiation and addressable devices. The Contractor shall furnish all parts, materials, and labor customarily required or provided for a completely coordinated, logical, and satisfactorily operating system, in accordance with all requirements applicable, even if every such item is not specifically shown or described in the project plans or specifications.
- B. The existing system shall remain operational during all hours the building is occupied until the modified system components are installed, tested, and accepted. Otherwise, a fire watch shall be maintained as required by the AHJ. The Contractor shall also coordinate impairments to the existing system(s) during construction and comply with NFPA 72 for interruptions extending beyond eight (8) hours.
- C. The system shall comply with applicable provisions of the 2018 NC Building Code (available for review at NCOSFM website), National Fire Alarm Code (NFPA 72-2013), National Life Safety Code (NFPA 101), and local building codes.
- D. System shall operate and function in compliance with NFPA 72 and NFPA 101.
- E. This specification has been written with the intent of complying with the NC SCO consensus document "Fire Alarm Guidelines and Policies" dated 2020 (available for review at NC SCO website).
- F. Approval of samples, cut sheets, shop drawings, and other matter submitted by the contractor shall not relieve the contractor of responsibility for full compliance with project plans and specifications, unless the attention of the engineer is called to each non-complying feature by accompanying letter, and the engineer has given written authorization for the specific deviation(s).
- G. Fire Alarm Contractor shall specialize in fire alarm system installation, be factory trained and certified, with a minimum of five (5) years documented experience installing and maintaining fire alarm system for similar installations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. The existing system is a Notifier by Honeywell at Hunt Hall, Notifier or similar series by same manufacturer (Contractor shall field verify), and Notifier NFP-200 at Reynolds Hall. The system and components shall be U.L. listed as a fire alarm system. All equipment supplied shall be specifically listed for its intended use and shall be installed in accordance with any instructions included in its listing. System shall use a nominal 24 Vdc operating voltage.
 - 1. Fire Alarm System Control - Existing to remain.
 - 2. Digital Alarm Communicator Transmitter – Existing to remain.
 - 3. Each AC input to the system panel, distributed amplifiers, and SNAC panel(s) shall be protected by a feed-through (not a shunt type) branch circuit transient arrestor such as Ditech DTK120SRD (DTK-TSS4D), Leviton 51020-WM-DIM, or equivalent UL 1449 – Third Edition listed device submitted to and approved by the Engineer in writing. Unit shall be rated for "Lightning Surges" since building is equipped with a lightning protection system.

Install suppressor in a listed enclosure near the branch circuit panel, trimming excess lead lengths. Wind a small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" in diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of suppressor on clipping fast rise time voltage transients.

4. Each DC circuit extending outside the building (such as the PIV, etc.) adjacent to FACU and also near point of entry to outside building, shall be protected by a "pi"-type filter on each leg consisting of a primary arrestor, series impedance, and a fast acting secondary arrestor that clamps at no more than 15V above nominal circuit voltage. Acceptable models are Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHLP24BWB series, Citel America B280-24V, and Northern Technologies DLP-42. Specifications on equivalent models may be submitted to and approval by engineer in writing. UL 497B listing is a prerequisite for consideration. Devices using only MOV active elements are not acceptable.
5. Remote Annunciators – Existing to remain.
6. Zone Maps – Update framed, detailed, graphic representation of the building, floor plans, zones, and devices, labeled to match the digital readout on the FACP, shall be provided adjacent to the FACP and annunciators. Final locations shall be approved by the Owner.
7. Pull Stations: Existing to remain. Notifier NBG-12LX series addressable type, dual-action, rugged construction. Mount at 46" AFF to center. All pull stations shall be provided with keyed locks for resetting purposes. Allen key type locks are unacceptable. Two (2) keys for each pull station shall be supplied to Owner.
8. Combination Audio/Visual and Visual Indicating Signals: Existing to remain. Alarm notification appliances, both audible and visual, shall comply with NFPA 72 requirements for intensity and placement. System shall be equipped with necessary module(s) such that all audible (on all floors) are synchronized and all visual (on all floors) are synchronized. The strobe shall be mounted 80 inches AFF or 6" below ceiling whichever is lower; and meets Accessibility Code. Indicate candela on submittal building drawings.
9. Ceiling Mounted Audio/Visual and Visual Indicating Signals: Existing to remain. Alarm notification appliances, both audible and visual, shall comply with NFPA 72 requirements for intensity and placement. System shall be equipped with necessary module(s) such that all audible (on all floors) are synchronized and all visual (on all floors) are synchronized. Indicate candela on submittal building drawings.
10. Ceiling and Duct Array Smoke Detector: Notifier FSP-851 addressable, intelligent, analog, low-profile, photoelectric detector with base B210LP or other base as necessary to meet functionality requirements. Smoke detectors shall be capable of magnet test. Ceiling mounted. Covers shall remain on detectors until building is free of dust and dirt.
11. Duct smoke detector: designed around Notifier DNR with FSP-851 addressable low-profile photoelectric smoke detector. Probe length shall extend the full width of the duct. Those over 36 inches long must be provided with far-end support for stability. Lengths to be determined by Electrical/Fire Alarm Contractor and Mechanical sub-contractor together. Provide each duct detector unit with a remote alarm indicator light (RAIL) and test station, Notifier RTS151KEY. Mount remote indicator light/test station on wall at 8'-0" AFF in the nearest corridor or public area. Detectors shall be installed by HVAC sub-contractor in ducts. Electrical/Fire Alarm Contractor shall wire to fire alarm system. Fire alarm AHU shutdown circuits shall be wired from the fire alarm control panel to a termination point, adjacent to the AHU control by fire alarm contractor. Mechanical sub-contractor shall make

all control wiring connections for shutdown of respective AHU via addressable control relay(s) at termination point activated by the fire alarm control panel. Addressable control relays shall be installed within three (3) feet of the controller for the equipment being controlled. All air handling systems shall be shutdown directly by the FACP during alarm shutdowns. Building automation systems shall not be used for alarm shutdowns of air handling systems.

12. Each duct detector installation shall have a hinged or latched duct access panel, 12x12 inches minimum, for sampling tube inspection and cleaning. Indicate airflow direction on the duct, adjacent to the detector, using stencil or permanent decal. Existing locations have access panels that are acceptable if duct detectors and sampling tubes are provided in the same location; otherwise, provide new access panels.
13. A supervised "AHU Shutdown Defeat" switch shall be provided in/adjacent to the FACU or as a key-operated function in the Remote Annunciator (where provided). If the RA option is utilized, provide an informative engraved at the FACU about this function; otherwise provide an informative engraved label at the switch provided in/adjacent to the FACU. The switch shall cause a system "trouble" indication when the switch is placed in the off-normal ("Shutdown Defeated") position.
14. Unless the AHJ requires otherwise, all duct detectors and duct smoke arrays shall be programmed for supervisory.
15. Interface devices: Monitor module. Devices shall be used to monitor sprinkler water flow switches, sprinkler tamper switches, etc. Locate these devices in environmentally controlled areas which do not exceed listed parameters. Devices shall have visible LED(s) on cover.
16. Control Relay Device: Notifier FCM-1 and FRM-1. Addressable relay module with contacts rated for 120vac, 20 amps (or add an auxiliary relay with contacts so rated). Addressable control relays shall be installed within three (3) feet of the controller for the equipment being controlled. Devices shall have visible LED(s) on cover.
17. Monitor Module Device: Notifier FMM-1 addressable monitor module Devices shall have visible LED(s) on cover.
18. Heat detectors: Notifier FST-851R addressable, intelligent, analog, low-profile, rate of rise heat detector with base B210LP. ceiling mounted, with fixed temperature and rate-of-rise sensing.
19. HVAC Controls: Provide control relay devices for each control point as indicated on the plans. In general, each air handler will require a control device relay to shut down unit. All control relay devices shall be equipped with an auxiliary relay with contacts rated for 120 volts, 20 amps. Addressable control relays shall be installed within three (3) feet of the controller for the equipment being controlled. Coordinate all with Mechanical plans and controls contractor.
20. Remote terminal cabinets: Size as required to house isolation modules, surge protectors, and wiring terminals. Locate in the individual floor electrical rooms or other convenient location (confirm with Owner). In multi-story buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
21. Fault isolation modules: Notifier ISO-X. Provide and install after each 20 devices and control points on any addressable loop, or a lesser number where recommended by manufacturer (confirm with installation instructions); for each addressable circuit that extends outside the building; in or immediately adjacent to the FACU, at each end of the

addressable loop (shall be in same room and within 15 feet of the FACU); and for loops with less than 20 devices and control points, install an isolator at the approximate middle of the loop (in addition to those at the FACU). Each isolation module shall be clearly labeled, readily accessible for convenient inspection (not above lay-in ceiling), and shown on the as-built drawings. Devices shall have visible LED(s) on cover.

22. Provide Owner with a complete test magnet assembly for periodic testing of all devices. Include any extension handles or other accessories normally needed for testing. This assembly shall become property of the Owner.
23. Wiring and cabling shall be provided as required by manufacturer for proper function of the system. Intent is for existing wiring to be utilized in new installation. If additional wiring and cabling is required, it shall meet the following requirements. Addressable loop (signaling line) circuits shall be wired with Type FPL/FPLR/FPLP fire alarm cable, 18 AWG minimum, low capacitance, twisted, shielded copper pair. Cable shield drain wires are to be connected at each device on the loop to maintain continuity, taped to insulate from ground, and terminated at the FACU. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802S19 (same as EEC 7806LC), West Penn D975, D991 (16 AWG), D995 (14 AWG), or equal wire having capacitance of 30 pc per foot maximum between conductors. Belden 5320FJ is acceptable if only FPL rating is required. All other circuits in the system shall be wired with minimum 14 AWG, stranded copper, THHN/THWN conductors. All wiring and cabling shall be installed in metal conduit.

Exception #1: Unshielded cable, otherwise equal to the above, is permitted to be used where the manufacturer's installation instructions unequivocally require, or state a preference for, the use of unshielded cable for all systems.

Exception #2: In underground conduit, provide Type TC or PLTC cable (PE insulated) to avoid problems with moisture.

24. Color code for fire alarm wiring shall be as follows (unless specifically required otherwise by manufacturer of the fire alarm system) without color change in any wire run:
 - a) Addressable loop – red cable jacket with red(+) and black(-) conductors.
 - b) Alarm notification appliance circuits – blue(+) and black(-) conductors.
 - c) AHU Shutdown Circuits – yellow(+) and brown(-) conductors.
 - d) Door control circuits – orange conductors.
 - e) Elevator capture circuits – brown conductors.
 - f) Circuits for addressable monitor modules to monitored devices (AWG 14) – violet(+) and grey(-) conductors.

Note: THHN/THWN conductors only are permitted if greater than AWG 16 (NCSEC 760.49(B)).

25. Notification Appliance Circuit booster ("ADA") power supplies must be individually monitored by the FACU and protected by a smoke detector per NFPA 72. They shall not be located above a ceiling, or in non-conditioned space.
26. 24 VDC power circuits serving addressable control relays shall also be monitored for integrity.

- B. Each individual addressable device (addressable loop number, device number) shall be uniquely identified. Each individual notification device (panel, circuit number, device number on circuit)

shall also be uniquely identified. This shall be shown on the “as-built” plans and in the System Status and Programming Report. A permanently mounted label shall be placed on each device base or device housing, whichever is appropriate, indicating its address or device number and associated SNAC panel and circuit. These labels shall be such that they can be read when standing on the floor at the device. In addition, all batteries shall be labeled with the date installed. Labels shall be made using electronic labeling system with black letters on white background. Write-on labels are prohibited.

All tamper and flow switches shall be provided with phenolic engraved tag permanently attached to device with address from fire alarm program. See identification specifications for color coding.

Contractor shall label all wires terminating in junction boxes and riser boxes. These labels shall be self-adhesive wire numbers.

Contractor shall provide a typed legend for all junction boxes and riser boxes corresponding to these labels. Legend shall be mounted in riser boxes. If system does not have riser boxes, contractor shall provide legend to Owner at time of acceptance.

- C. The following spare parts shall be provided, each individually packaged and labeled, and turned over to Owner upon acceptance of the system (minimum of two (2) each; otherwise, round fractional quantities to next higher number). All spare parts shall be new and unused.
1. Two (2) fuses of each type and size used in the system.
 2. 2% of total installed manual pull stations.
 3. 4% of total installed addressable control relays.
 4. 4% of total installed horn/strobes (of both wall and ceiling).
 5. 4% of total installed strobes (of both wall and ceiling).
 6. 4% of total installed monitor modules (addressable interface).
 7. 4% of total installed isolation modules/isolation bases.
 8. 4% of total installed addressable heat detectors.
 9. 6% of total installed ceiling smoke detectors.
 10. 6% of total installed sounder bases.
 11. Two (2) keys per installed pull station.
- D. The contractor shall provide any special equipment, tools, and programming devices required for the operation, maintenance or repair of the installed fire alarm system.

2.2 FUNCTION

- A. Activation of any alarm initiating device (detector, pull station, etc.) shall cause the following:
1. Sound audible devices throughout the facility.
 2. Strobe lights shall flash.
 3. An alarm shall sound and a visual signal indication at the fire alarm control panel and at any remote annunciators.
 4. The device(s) from which the alarm(s) originated shall be distinctly annunciated at the fire alarm control panel and at any remote annunciator panels. Also the annunciation shall indicate the device type(s) in alarm.
 5. The contacts for the remote communications shall be activated.

6. Transmit "Fire Alarm" signal to Central Station.
- B. Air handling systems and fans shall be shut down by activation of the fire alarm system. These signals shall be accomplished by relay controls and contacts furnished as part of the fire alarm system. All HVAC control wiring into the relays and contacts shall be by the Mechanical Contractor. Program relays as directed by the Mechanical Contractor.
- C. System trouble shall be indicated audibly and visually at the fire alarm control panel. This shall be a sound that is individually distinguishable from the alarm signal.
- D. Elevator smoke detectors: Primary and/or alternate recall points shall be indicated on the control Matrix. Elevator capture or control signals shall come from the FACP as relayed by control modules.
- E. Alarm initiating loops shall be supervised. Wiring and type devices used shall be such that failure of *any* device on a loop shall cause a distinctive trouble signal at annunciator panels, but failure of any device on a loop shall not preclude initiation of an alarm signal by any other device on the loop. In addition, all loops shall be supervised to provide a trouble indication in case of an open circuit or ground fault in either (or any) conductor.
- F. Alarm notification appliance circuits (NAC) shall be NFPA 72 Style Y (Class B). The load connected to each circuit must not exceed 80% of rated module output and the coverage of each shall be limited to one floor. The NAC voltage drop during alarm shall not exceed 14% of the voltage measured across the batteries at that time. The contractor shall use power outage testing to verify the NAC circuit is designed and installed properly. Shop drawings must show calculated NAC current draw and voltage drop at the EOL.
- G. Addressable loop controller (signaling line) circuits shall be fully NFPA Style 6 (Class A) with no "T" taps. Each loop must have a minimum of 20% spare address for future use. At a minimum, provide one addressable loop per floor. The supply and return conduit shall have at least three (3) feet of separation between them at all times.
- H. All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature shall be armed and sensitivities set prior to acceptance of the system. Smoke detectors' sensitivity shall be monitored at panel, and alarm threshold for each shall be adjustable. Contractor shall verify sensitivity settings of all devices.
- I. Spot type detector shall be the plug-in type with a separate base (not mounting ring) to facilitate replacement and maintenance. The bases shall have integral terminal strips for circuit connections rather than wire pigtails. Each detector or detector base shall incorporate an LED to indicate alarm.
- J. Spot type smoke detectors shall have a built-in locking device to secure the head to the base for tamper resistance. For detectors mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.
- K. Install breaker locks for circuit(s) feeding FACU and SNAC panels. In addition, provide 1/4" painted red dot to handle or exposed body area.
- L. The following by-pass switches shall be programmed (where applicable) into the system: audio/visual by-pass; HVAC shutdown by-pass, door hold open by-pass, elevator capture bypass, etc.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring shall be in metal raceway (3/4' EMT minimum). All conduits that penetrate outside walls from air conditioned space must have internal sealing (duct-seal), to prevent condensation from infiltrating humid air.
- B. The FACU and all other control equipment locations, including any transponders, sub-panels, annunciators, DACT, and booster power supplies, shall be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).
- C. All junction and pull boxes shall be painted red prior to pulling wire unless installed in finished areas.
- D. No T-taps are allowed in system wiring.
- E. No splices are allowed in the system wiring. All wiring runs shall be continuous between devices. Use terminals on devices or terminal cabinets on each floor. "Wire nuts" and crimp splices shall not be permitted. Floating terminal strips shall not be permitted.
- F. Permanent wire markers shall be used to identify all connections at the FACU and other control equipment, at power supplies, and in terminal cabinets. In addition, for wiring inside terminal cabinets, affix typed professional legend to inside of terminal cabinet doors indicating wiring diagrams, line/load direction, etc.
- G. Addressable interface modules (used to monitor all contact type initiating devices) shall be located in a conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location. With AHJ approval they may be permitted to serve as many as three (3) sprinkler system valve supervisory switches, or six (6) heat detectors, in a single space.
- H. On fire alarm notification circuits and end-of-line resistor shall be located as follows:
 - 1. In a location that is accessible to the fire alarm maintenance personnel.
 - 2. In an area where maintenance or testing at the EOL resistor location will not be disruptive to the normal use of the facility.
 - 3. In an area that is not easily accessible to the normal building occupants (objective is to avoid accidental or malicious damage by building occupants).
 - 4. In an area that is no higher than 9'0" or lower than 7'0" from the finished floor level.
 - 5. Shall not be located in a stairway or bathroom.
- I. No isolation modules, relay modules, interface modules, terminal cabinets, etc. shall be located above drop ceilings.
- J. Unless suitably protected against dust, paint, etc., spot type smoke detectors shall not be installed until the final construction clean-up has been completed. In the event of contamination during construction, the detectors shall be replaced at the contractor's expense. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and shall not be used for that purpose. These covers are suitable only during final, minor cleanup or touchup operations.
- K. Electrical and Mechanical Contractors shall include two (2) relocations per duct detector specified on drawings to assure working placement in ducts. Coordinate with Mechanical Contractor.
- L. Notification Appliance Circuit booster ("ADA") power supplies must be individually monitored for integrity and are not permitted to be located above a ceiling, or in non-conditioned space. Any 24vdc power circuits serving addressable control relays must also be monitored for integrity.

- M. All connections to FACU and system's programming shall be performed only by supervision and the manufacturer or a manufacturer authorized distributor. Manufacturer trained and certified installers shall be used for all connections to the fire alarm control panel and for all system programming. This manufacturer's specific training and certification must have occurred within the most recent 24 months, except NICET Level III Certification will extend to 36 months. Copies of the certifications for the specific FACU model/series being installed shall be included with the contractor's submittal package. The submittal package will not be approved without this information. Manufacturer's authorized distributor shall stock a full complement of spare parts locally for the system. The technician who makes the final connections and programs the FACU is legally the "installer". The responsibility for assuring a proper installation overall rests with this individual.
- N. Programming of the system shall include activating the automatic drift compensation feature for all spot-type smoke detectors. Set smoke detector sensitivities to normal/medium, unless directed otherwise by the Engineer or Owner.
- O. All intelligent fire alarm systems shall be zoned. Systems shall be zoned first by floor, then by wing (N,S,E,W), if applicable. System shall also be zoned at any fire partitions or identifiable building features. System devices shall be zoned by type (i.e. smoke detectors, pull stations, heat detectors, duct detectors, sprinkler system monitoring components, etc. shall be on separate zones. Combining separate types of devices on the same zone is prohibited. Any LED type annunciators shall have separate zone lights for alarm (red) and trouble (amber). All supervisory LEDs shall be amber in color.
- P. Print-out a complete "System Status and Programming Report" after completing the above. This print out shall include the program settings for each alarm initiating device and for smoke detectors, its current sensitivity.
- Q. The manufacturer or the authorized distributor shall 100% test all site-specific software functions for the system and then provide a detailed report showing the system's operational matrix. This documentation shall be a part of the "System Status and Programming Report" described herein. Contractor shall provide written notification to engineer of the 100% test one week prior to testing commencement to allow the option of witnessing any or all of the testing.
- R. After completion of the installation and all programming, the fire alarm technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliance for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator recall, control of HVAC systems, release of smoke doors, etc. This final testing of the system shall be under the direct supervision of the manufacturer or the authorized distributor.
- S. Testing of smoke sensing devices shall be accomplished using manufacturer and NFPA approved methods for all devices.
- T. After all tests are complete, the Contractor shall submit the following documentation to the owner, through the engineer, prior to the owner demonstration described below:
 - 1. NFPA 72-2013, "System Record of Completion" form and associated applicable supplementary forms. No substitutions are acceptable. Form shall confirm (a) it was installed and tested per Code and (b) the Code required 100% test was performed. The fire alarm installer shall sign Form in the applicable locations. If a representative of the AHJ, Owner, or engineer witnesses the tests, they sign the last line of the form to signify that fact only (annotating the form as needed).
 - 2. NFPA 72-2013, "System Record of Inspection and Testing" form.

3. An HVAC balance report in the smoke control/purge mode (if smoke evacuation system is provided).
 4. The "System Status and Programming Report" described above. This report shall be one generated on the day of the system acceptance inspection.
 5. Battery calculations per NFPA 72.
 6. Written verification the system was tested and successfully completed the Fire Alarm System Checklist provided in the Appendix A. Engineer will certify the system based on the checklist.
- U. Owner shall be thoroughly instructed and trained on the function, use, and maintenance of the system. A minimum of eight (8) hours on-site time will be allocated for this purpose. An additional two (2) hours of instruction shall be individually provided for the second and third shifts. Provide two (2) copies of a written, bound summary of the training for future reference. Written verification of this training shall be forwarded to the Engineer. Training shall include, but not be limited to, the following: how to replace heads and set addresses if not set automatically; how to locate a short in a circuit; how to replace electronic cards (shall be third party listed) and where to mount them in the panel; get familiar with functionality of each electronic card; how to perform/generate dirty head test report and sensitivity test report; how to synchronize strobes for the entire building; how to check circuit ground faults and how to clear them; how to interpret the display field codes (A=Alarm, S=Supervisory, T=Trouble, M=Modules, etc.); and how to locate faulty modules from the trouble display codes. At the completion of training, the contractor shall install a faulty smoke head within the system. The trainees shall then find the fault and correct it under the supervision of the contractor.
- On-site training shall also include:
1. variable changes
 2. programming changes
 3. report creations and changes
 4. system functional changes
 5. hardware repair and maintenance of all building panels and devices, including but not limited to, diagnostic procedures, system expansion, and maintenance techniques.
- V. Contractor shall provide the training, technical manuals, spare parts, and system documentation prior to system acceptance testing by Engineer, Owner and AHJ.
- W. After completion of the Code required 100% test described above and submission of documentation, training and parts described above, a demonstration of the entire system shall be provided for the Owner and Engineer. System shall have operated for at least two full days prior to this demonstration. Manufacturer's field engineer or technician shall be present for these demonstrations and shall assist the Contractor in performing the demonstration. This demonstration shall consist of functional testing of the system as directed by the owner and engineer.
- X. Contractor shall arrange to have the necessary number of people, 2-way radios, etc. including the manufacturer's representative on hand for these demonstrations of the system. Again, demonstrations shall use approved smoke methods, not magnets. Contractor shall furnish a smoke machine as necessary to test system for all testing – Code, Owner/Engineer, and AHJ (see section V. below).

- Y. Once system is operational and accepted by the Owner and Engineer, Contractor shall be prepared for a complete demonstration of the system for the AHJ during their inspection. The manufacturer's field engineer or technician shall also be present for this demonstration.

3.2 SUBMITTALS

- A. Contractor shall submit complete shop drawings to Engineer for approval prior to performing any work. These shall clearly demonstrate compliance with the drawings and specifications. Any non-compliant features shall be fully described.
- B. Contractor shall submit a site specific single line riser diagram (manufacturer's typical wiring diagrams are not acceptable) and site specific building plan drawings showing cabling and wiring requirements, Class A loops, conduit sizes, outlet and equipment locations, device addresses, and color coding of system submitted in electronic format (ACAD). Drawings shall include design ambient sound level, audible alarm device sound power and alarm sound level for each space or Contractor shall certify the design meets NFPA 72 for sound levels. *Any additional devices required while verifying the system shall be at Contractor's expense.*
- C. Submittals shall include a copy of the system battery sizing calculation. Contractor shall use manufacturer's battery discharge curve to determine expected battery voltage after 24 hours of providing standby power. In addition, the contractor shall use the calculated NAC current draw in the alarm mode to determine expected voltage drop at end of line (EOL), based on the conductor resistance per manufacturer's data sheet or latest edition of the NEC. Circuit resistance shall include doubling the ohms per foot to incorporate two conductors required to power circuit. In addition, include any inherent voltage drop caused by the system's power supply.

The voltage drop at EOL shall not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. Contractor shall determine worst case voltage at the far end of each NAC by subtracting the calculated voltage drop from the expected battery voltage. The result shall be no less than the minimum listed operating voltage for the alarm notification appliances being used.

All of the calculation noted above shall be placed on a dedicated sheet of as-built drawings. NAC voltage drops shall be verified during system testing by contractor.

- D. A pre-construction meeting shall be mandatory for the electrical contractor and fire alarm sub-contractor to meet with the Owner and Engineer to review the specifications, submittals, items noted in A. above, as well as discuss any other pertinent items.
- E. Upon satisfactory installation and testing, the Contractor shall provide to the engineer two (2) bound copies of the following technical data for transmittal to the Owner:
1. "As-built" site specific single line wiring riser diagram showing all loop numbers and device addresses in the system, plus equipment terminal numbers.
 2. "As-built" site specific building plan drawings similar to drawings required per 3.2.B.
 3. "As-built" voltage drop and battery sizing calculation sheets.
 4. Manufacturer's detailed maintenance requirements.
 5. Technical literature on all control equipment, isolation modules, power supplies, alarm/supervisory signal devices, alarm notification appliances, relays, etc.
 6. Electronic copies (ACAD 2018) on portable "jump drive" for items 1, 2, and 3, and PDF's for items 1, 2, 3, 4, and 5.
 7. Contractor shall provide all software required for full system maintenance and upgrades to fire alarm system including any device changes, additions, or deletions.

- F. Complete configuration data (site-specific programming) for the system shall be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A portable “jump drive” copy of this data shall be submitted to the owner via the engineer prior to acceptance of the system.
- G. The manufacturer of authorized distributor shall maintain software version records on the system installed. System software shall be upgraded free of charge during the warranty period if any new versions are released during that time period. If a new upgrade is released to correct operating problems, a free upgrade shall be provided during the entire life of the system.
- H. Basic operating instructions shall be framed and permanently mounted at the fire alarm control panel. If owner concurs, they may be affixed to the inside of the control panel door instead. In addition, a copy of the NFPA 72 “Record of Completion” shall be provided at or in the FACP in a rigid pocket provided by the contractor.
- I. Provide an engraved label meeting Section 260553 of these specifications on the at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance panel, digital alarm communicator panel, etc., identifying the 120VAC power source as follows: panel location, panel identification, and branch circuit number.

3.3 WARRANTY

- A. After acceptance by the Owner, a full year of maintenance in perfect operating condition shall be provided by Contractor and supplier at no additional expense to the Owner. This warranty coverage shall include parts, labor and travel to and from job site.
- B. Contractor shall provide all software updates during the warranty period and upgrades to software following the warranty period that address system operating failures or defects during the life of the system.

APPENDIX A – FIRE ALARM TESTING CHECKLIST

FIRE ALARM SYSTEM CHECK LIST



BUILDING NAME: _____ LOCATION: _____

DESIGNER: _____ INSTALLER: _____

INSPECTION BY: _____ DATE: _____

Preparation for Acceptance Test

- ☐ Fire authorities have been notified of the system test. Also notify any location where alarms are transmitted. DO NOT ROLL FIRE TRUCKS BY ACCIDENT. All building occupants have been clearly notified of the system test.

All required documents are on site for the SCO inspection and review.

- ☐ A copy of the project plans and specification
- ☐ A copy of the contractor's approved shop drawings including:
 - o cut sheets
 - o battery size calcs
 - o Matrix
 - o plans
 - o Voltage drop calcs
 - o Training Certificates
- ☐ A copy of the Fire Alarm system "as built" drawings showing the routing of circuits installed
- ☐ Final NFPA 72 "Fire Alarm System Record of Completion" form
- ☐ A copy of the System Operation Matrix, giving the FACU response for each initiating device input, has been provided by the fire alarm installer to facilitate testing.
- ☐ A copy of the sensitivity report
- ☐ A copy of the printout generated by the 100% device testing

NFPA 72 "Record of Completion"

- ☐ **NFPA 72 "Record of Completion" Form, filled out, with all signatures and at FACU**
- ☐ Appropriate year of form is used per year of Building Code permit
- ☐ Appropriate chapters must be indicated (see chapter list in the reference section of document)
- ☐ The manufacturer's authorized distributor (by definition the "installer") who made final connections at the FACU and programmed the system gave the owner and AHJ advance notice of the required 100% operational tests, so they could elect to attend.
NOTE: The required 100% testing cannot properly be done by a single technician without a helper, even if the FACU has Walk-Test or an equivalent feature. Query the tech on how testing was performed.
- ☐ Signatures on the form must match the typed/printed names and each section must be complete. Do not accept a company name in place of the responsible individual. The individual must have a certificate. NOTE: If part or all of the testing was witnessed by a representative of the AHJ, the final line of the form is signed to indicate that. (SCO design contracts give that responsibility to the electrical PE.)
- ☐ Verify the technician who programmed the alarm system was trained and certified by the manufacturer, for the specific FACU model being installed, within the past 2 years. (A copy of the cert. should have been submitted with the Shop Drawings.) NICET Level III certification will extend this to 36 months.

REVIEW THE FOLLOWING ITEMS FROM THE SHOP DRAWING SUBMITTAL:

- ☐ Contractor has submitted battery calculations to the designer, verifying the system meets applicable capacity requirement of NFPA 72. The minimum endurance is 24 hours plus 5 minutes of alarm load. See the specification for additional requirements imposed by the AHJ.
- ☐ Battery sizing calculations verifying adequate Amp-Hour rating, indicating that the worst case NAC voltage on battery is within alarm notification appliance listing, and that NAC alarm load voltage drop at EOL does not exceed **14%** of battery voltage.
- ☐ Notification Appliance Circuit (NAC) calculated current draw, demonstrating that none exceed 80% of rated module output.
- ☐ If system is the Emergency Voice/Alarm type, amplifier load calculations.
- ☐ Copy of factory training certificates for technicians who programed the system.

REVIEW THE FOLLOWING ITEMS FROM 100% Test:

- ☐ **System Status and Programming Report, which includes the following 3 elements:**
 - ☐ Program settings for each alarm initiating device
 - ☐ Current sensitivity reading of each smoke detector
 - ☐ System operational matrix, giving response for each alarm input

- ☐ **If building has smoke purge system, an HVAC balance report in purge mode**
- ☐ **Two bound copies of the following information on the system (may be combined):**
 - ☐ Manufacturer's technical literature (cut sheets) on system components
 - ☐ Required maintenance schedule on system, to comply with NFPA 72
 - ☐ As-built drawings with loop #'s, device addresses, equipment terminals

COMPARE DOCUMENTS TO INSTALLATION

Shop drawings calcs:	NFPA 72 says:	Installed size is:
FACU batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
NAC batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
DACT batteries ____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each	____ AHr ____ @ ____ V each
SLC loops _____ class _____	_____ class _____	_____ class _____
NAC Circuits _____ class _____	_____ class _____	_____ class _____

Check Fire Alarm Control Panel(s)

- ☐ **VERIFY SYSTEM IS IN TEST MODE AND THE FIRE TRUCKS WILL NOT ROLL.**
- ☐ Operating instruction summary is framed and mounted at (or inside) the FACU.
- ☐ Green grounding wire is bonded to FACU cabinet, and also connected to designated terminal on motherboard (if any).
- ☐ AC Power
 - Branch circuit to FACU does not share conduit with 24vdc alarm initiating circuits or notification appliance circuits.
 - Circuit breaker(s) serving FACU (and associated equipment) have lock on clips and red dot at breakers. (Some electricians will not paint the handle to avoid damage to the breaker)
 - Placard inside FACU gives the following info on this circuit: **Panelboard location, panelboard identification, and branch circuit number** (The same applies to SNAC panels and any other system control equipment)
 - Surge arrestor model listed in project spec (feed-through type with "pi" configuration) is installed at electrical panelboard, on the 120vac branch circuit to FACU. Arrestor leads are trimmed as short as practical. See attached wiring diagram for more info.
- ☐ Fire alarm control unit (FACU) is powered up and clear of alarms, supervisory signals, and trouble conditions.
- ☐ Have ground fault put on any alarm initiating or notification appliance (horn-strobe) circuit. FACU must indicate "ground" and general "trouble." Verify this ordinary "trouble" signal is not sent to any Remote Supervising Station.
- ☐ Record battery size and verify date of installation is marked on each battery (Marking of the date of manufacture of the battery is a code requirement – so you will find 2 dates)
- ☐ Have technician disconnect a battery lead and verify the FACU indicates a local trouble signal within one minute of that action.
- ☐ Reconnect battery, **then** turn off 120vac. Batteries should measure approx. 13 volts, and differ ≤ 0.4 volt. (Also check batteries in any booster power supplies.)
- ☐ If system is connected to Remote Supervising Station, verify the FACU did **not** transmit AC Power Failure "trouble" signal, as it was not maintained for 1-3 hours.
- ☐ Have technician confirm FACU is programmed to send an AC power failure trouble signal to Remote Supervising Station if power loss continues for 1 hour minimum to 3 hours maximum. Also, verify that no other types of "trouble" signals are reported.

- ☐ The FACU and any transponders, sub-panels, DACT and "ADA" booster power supplies must be protected by a smoke detector within 15 feet of their location, measured horizontally, as required by Code (NFPA 72).
- ☐ Addressable loop controller circuits are Class "A", with isolation modules at FACU on the outgoing and return loop, after each 25 addressable devices (max) on the loop, and (if ≤ 25 devices) at midpoint.
 - Have the technician apply a short circuit on the SLC loop. This will force two isolation modules to clamp. The test is to verify their operation and device count between the two that clamp.
 - With AC power off, there will be multiple troubles on the system. The total count will increase during this test. Exclude the count prior to the short.
 - On retrofit and repair work where the AHJ has approved the use of a class B SLC wiring design the isolation modules will not be installed.
 - Verify the number of devices between Isolation modules meets the specification requirement.
- ☐ While on battery power, initiate Alarm. Batteries should remain at 12+ volts each, but dropping slowly. Let alarm continue during next step.
- ☐ Verify the Notification Appliance Circuit (NAC) voltage drop at the EOL is ≤ 3 volts. Do this separately for each NAC. Look at the shop drawing to find the worst case scenarios when spot checking at a final.
- ☐ Silence the alarm and verify that any Remote Supervising Station has received a fire alarm signal. Reset the FACU and verify the Station receives a subsequent "restore" signal, indicating the alarm condition has been cleared.
- ☐ Verify requirements on wire type and gauge were followed and that the color code for circuits is proper throughout the system. (Review specifications and shop drawing requirements.).
- ☐ Have installing technician demonstrate that the system is programmed so all **spot-type** smoke detectors have automatic drift compensation and FACU will indicate when prescribed sensitivity limits are reached or exceeded.
- ☐ If system has provisions for "alarm verification" algorithm, arm it only if needed for the environment. Do **not** apply it to multi-sensor or multi-criteria smoke detectors.
- ☐ If any addressable control relays are installed, verify their contact ratings are suitable for connected load. (Some are rated for resistive loads only.) Also, if they require separate 24vdc power for operation, verify the circuit is electrically supervised. Compare their installed location to the design intent.
- ☐ All field wiring in the system has wire markers where landed at the FACU, and also in the terminal cabinet(s) on each floor of multistory buildings.
- ☐ If system uses an LED "zone" annunciator to provide a quick visual overview of the fire scenario for responding public safety personnel (general fire area and type of alarms), a framed directory or typed/engraved LED labels provide clear information on "zone" (area) boundaries and the type(s) of alarms (i.e., smoke, waterflow, etc.)
- ☐ During the walk through of the site verify that there are **no** splices in the system wiring other than at terminal blocks which are installed in identified terminal cabinets. "Wire nuts" and butt splices are not permitted on new work.
- ☐ All circuits are properly and securely terminated. Approved terminal fittings are used for any stranded wire terminations at screw posts that lack pressure connectors.

- ☐ Initiate alarm on a representative sample of devices by operating manual fire alarm box, blowing smoke into detector, flowing water from sprinkler system inspector's test station, etc., except do not test any non-restorable, fixed temperature heat detector. (get total counts from 72 form)
 - ☐ Photo smoke ____/____ ☐ Duct smoke ____/____ ☐ Heat detector ____/____
 - ☐ Ionization smoke ____/____ ☐ Other detector ____/____ ☐ Flow switch ____/____
 - ☐ Pull Station ____/____ ☐ tamper switch ____/____ ☐ ____/____
- ☐ For each device tested have FACU operator read out the FACU display and the LED display. (Radios are very helpful at this point.) There should be a clear indication of device type, device number and location for each device tested.
 - Individual detectors of all types shall be identified on their bases (Loop # -- Device #), in sequence on the loop from the FACU
- ☐ While spot testing devices in the facility verify operation of audible-visible alarm notification appliances.
 - Audible alarm devices must be 15 dBA above normal ambient sound level in all occupiable areas of building. (Use meter if in doubt.)
 - Indoor strobes must flash 60-120 times/minute and those installed in a single space (room, corridor, etc.) must be synchronized and remain synchronized throughout the test.
- ☐ Also verify HVAC shutdown and closure of (any) smoke doors. These functions must be done by the FACU, rather than by integral smoke detector relay contacts.
 - Shutdown must occur within 20 seconds, except gas pack units can be arranged for up to 60 seconds delay before the fan stops, to prevent heat exchanger damage.
 - After verifying the HVAC shutdown is operational it is acceptable to activate the HVAC bypass to avoid excessive restarting of large air handler systems.

ELEVATORS

- ☐ Elevator control key and technician must be on site for the following tests to take place
- ☐ Elevator lobby detectors must be within 21 feet of each elevator door
- ☐ Test detector(s) located at elevator lobby that will initiate elevator recall
 - Verify recall to a primary floor
 - Verify recall to alternate floor
 - Verify illumination of "Fire Hat"
- ☐ Test detector(s) located in shaft & elevator machine room
 - Verify recall to designated floor
 - Verify flashing illumination of "Fire Hat"
- ☐ Heat Detectors installed in a shaft or machine room and used for shunt trip activation shall be located within 2 feet of each sprinkler head. (Verify heat setting is less than sprinkler setting per code req.)

SPRINKLER SYSTEMS

- ☐ If a sprinkler system is present, check the operation of the waterflow alarm switches by flowing water from Inspectors Test connection(s), unless dry pipe system. Alarm sounds in 20-45 seconds and any outside water motor gong rings properly in ≤ 300 seconds.
- ☐ Inspectors Test Connection flow is limited to 1/2" stream (or actual orifice size of the sprinklers in the system, if different) by a valve or sight glass marked accordingly, or by a sprinkler head (minus deflector) mounted at discharge. NOTE: If a pipe union with an internal restrictor plate is used for this purpose, have the sprinkler contractor take it apart for inspection, to verify the orifice size.
- ☐ Close any electrically supervised sprinkler control valves to verify supervisory alarm at FACU within 2 turns of control wheel or, for Post Indicator Valve (PIV), within 1/5 of valve control mechanism's travel distance. Then reopen to verify "restore" signal.
- ☐ If dry pipe or pre-action sprinkler system, have contractor demonstrate waterflow alarm functions, and that both high and low air pressure are supervised as required.
- ☐ Each fire extinguishing system, such as in a kitchen hood, is connected to give building fire alarm. Have contractor demonstrate that this functions properly, by manually operating the monitored switch, without releasing extinguishing agent.

NOTE: Kitchen hood fire extinguishing system activation must shut off the gas, if used, and, for wet chemical type, also operate a shunt trip breaker to shut off the electric power to all protected appliances under the hood. The exhaust fan(s) keep running but the make-up air must shut down. These functions are to be done directly by fire extinguishing system, rather than the FACU, since it is not appropriate to cut off the gas supply or to operate the shunt trip for other types of alarms not involving the kitchen hood extinguishing system (e.g., smoke detectors, fire alarm boxes, etc.).

- ☐ Verify that fire alarm system monitors power to any fire suppression system shunt trip breakers. (Look for kitchen hood systems and sprinklered elevator spaces.)
- ☐ If remote alarm annunciator in building, verify proper operation, including the audible "Trouble" signal. Check its "Lamp Test" and "Trouble Silence" features, if provided.
- ☐ If a Fire Pump is part of the sprinkler system – verify that NFPA 20 certification was provided and testing has been successfully completed

OTHER SUPPRESSION SYSTEMS

- ☐ Pre-action suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel
- ☐ Dry Chemical suppression system – If installed and if it has an independent control panel it will require a separate NFPA 72 certificate from the building Fire Alarm Panel

PROPER INSTALLATION OF DEVICES

- ☐ Verify all dust covers have been removed. If still installed how was the 100% test done?
- ☐ Spot type smoke detectors shall not be located within 3 feet of a supply or return air diffuser, nor in a strong air stream from a supply diffuser at any distance.
- ☐ Wall-mounted smoke detectors must be installed between 4 and 12 inches from the ceiling (measured to the nearest edge of the detector), as required by NFPA 72.
- ☐ Wall mounted detectors shall not have wall-mounted luminaires or other obstructions below.
- ☐ Ceiling mounted smoke detectors shall be at least 4 inches from a wall or ceiling obstruction.
- ☐ All smoke detectors are analog addressable model(s) having a separate plug-in head, concealed locking device, and terminal strips for circuit connections.
NOTE: Snap-ring mounted models with removable terminal strip plug for connection to loop conductors do not comply with the intent of this requirement and typically do not have a locking device to deter tampering.
- ☐ Verify that the isolation modules and addressable initiating device interface modules are located in a conditioned space (not attics, boiler rooms, unheated warehouses, damp locations, outside corridors, parking decks, etc.). Exception: Any devices that are specifically listed for the ambient conditions expected (or likely) in the area where installed.
- ☐ Verify that all detectors, modules and pull stations installed outside or in non-conditioned spaces are listed for use at the both ends of the expected temperature. (eg Typically addressable pull stations are not listed for use in parking decks because the low end is 32 degrees.)
- ☐ Verify that any strobes in walk-in coolers or freezers are listed for that environment or provided with heated Lexan enclosures for which they are specifically listed.
- ☐ Check any outside alarm bells and strobes for operation. Verify outside strobe is the weatherproof type with at least 100cd output, double flash, with clear lens.

DUCT SMOKE DETECTORS

- ☐ Intake tube has its holes /slots facing into the air stream, and a stopper installed to seal its far end.
- ☐ If the tube is over 36 inches long, the far end must be supported for stability. If support is provided by extending the intake tube through the far side of HVAC duct (best for inspection, cleaning, testing), the duct penetration must be sealed.

- ☐ Each duct smoke detector has a Remote Alarm Indicator Light (RAIL) in nearest corridor or other public space. (Because addressable, test switch is **not** required.)
- ☐ At each duct detector a 12"x12" minimum access door, hinged or latched type, is provided to facilitate sampling tube inspection and cleaning.
- ☐ Air flow direction is permanently indicated on the duct by stencil or decal, to help assure the sampling tubes are installed and maintained in the correct orientation.

DACT

- ☐ **Verification of the dial out ability** or other means of remote alarm signaling
- ☐ Verify that DACT it is connected and functioning properly, to transmit fire alarm, supervisory, and trouble signals as separate, distinct events.
- ☐ Verify two phone lines are present and labeled when sprinkler is installed.
- ☐ Verify that DACT is programmed for 24-hour silent test call to the supervising station.
- ☐ Verify each type of signal is properly received and coded at the receiving station. (Supervisory signals include sprinkler valve tamper, fire pump off-normal, hi-low air pressure, etc.)
- ☐ Inspector is to personally talk to someone at the receiving station to verify alarm receipt

PRINTER

- ☐ The specification should require that systems with more than 100 addressable points, or in a building that exceeds 3 occupied floors or 60,000SF, an event printer is to be provided which uses ordinary non-thermal paper. In a high rise building, the printer must be FACU-monitored and on a generator-supported circuit.
 - NOTE: Printer does not have to be adjacent to FACU and, except for high rise buildings, does not have to be electrically supervised.

OTHER SYSTEMS

- ☐ For dormitories there will be special testing required for the sounder bases and the handicapped notification which uses higher candela strobes. Even if system is dual event it must dial out on 1st alarm.
- ☐ For institutions check for keys to the lockable pull stations if they are installed.
- ☐ Where smoke "sniffer" systems are used - create a test procedure with the help of the designer.
- ☐ Where beam detectors are used verify they are not on walls subject to movement and are not subject to direct sunlight.
- ☐ Where smoke evacuation &/or AHU bypass is used verify that the panel can be locked and operation limited to qualified people.
- ☐ Mass Notification systems require special procedures and testing to verify proper operation.

TRAINING ETC

- ☐ Verify that the Owner's designated personnel have received training in system operation: How to interpret, silence, and reset FACU signals, how to obtain service, etc.
- ☐ Verify that when required by specification, owner's personnel have received more thorough, detailed training in system troubleshooting and repair, plus installation manuals and other documentation, as applicable. (This is standard for the UNC-Chapel Hill campus.)
- ☐ Contractor has provided electronic copy of system's site-specific programming. (CD, flash drive)
- ☐ Contractor has provided spare parts in accordance with the specification for the project.

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

After the required 100% system operational test the contractor submits a "final" copy of NFPA 72* "Fire Alarm System Record of Completion" form. This form is to verify the proper operation of all (restorable) alarm initiating devices, audible and visible notification appliances, and other system functions including HVAC control, closure of smoke doors and dampers, pressurization fans, remote signaling, etc.

*Use only the NFPA form, or an identical reprint. The NFPA 72 form will vary with the year the project was permitted. The year required should be listed in the project specification.

NC Building Code, Chapter 35 Referenced Standards set the NFPA 72 version requirements

Projects permitted under NC Building Code 2002 - NFPA72 1999

Projects permitted under NC Building Code 2006 - NFPA72 1999

Projects permitted under NC Building Code 2009 - NFPA72 2002

Projects permitted under NC Building Code 2012 - NFPA72 2007

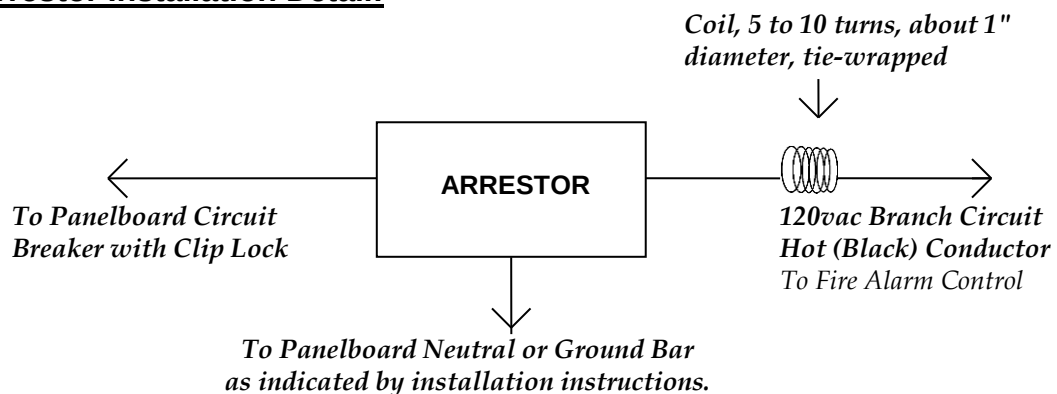
NFPA 72 Chapters (note they vary by version year)

(1999) Chapters: 1-Fundamentals, 2-Initiating Devices, 3- Protected Premises, 4-Notification Appliances, 5- Supervising Station FA system, 6- Public FA reporting systems, 7-Inspection and Testing, 8-FA for Dwelling units, 9-Reference publications_____

(2002) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

(2007) Chapters: 1- Administration, 2-Referenced Publications, 3- Definitions, 4- Fundamentals, 5- Initiating Devices, 6- Protected Premises, 7- Notification Appliances, 8- Supervising Station FA system, 9- Public FA reporting systems, 10- Inspection and Testing, 11- Single and Multiple Station & Household_____

Transient Arrestor Installation Detail:



NOTE: Securely mount transient arrestor in accessible junction box or other proper metal enclosure adjacent to the panelboard, and provide engraved label indicating its location

REFERENCE INFORMATION TO ASSIST SYSTEM INSPECTION

Wiring: All addressable system wiring shall be color coded in accordance with following scheme, which must be maintained throughout system, without color change in any run:

- Addressable Loop Controller Circuits: Cable per spec, with Red Jacket and Red(+) and Black(-) Conductors
- One-way Voice/Alarm and Two-way (Fireman's Telephone): Wire per specifications

The following circuits use THHN / THWN conductors, of the size and color indicated:

- Alarm Notification Appliance Circuits: AWG 14, Blue(+) and Black(-) conductors
- AHU Shutdown, Elevator Capture, other control functions: These are now done by addressable control relays on the loop. The relays may require separate power circuits, in which case use AWG 14 conductors, with Yellow (+) and Brown (-) color code. **NOTE: Check any power circuits to addressable relays for electrical supervision by disconnecting 1 lead.**
- Circuits that power door magnets from the FACU or SNAC panels: AWG 14, Orange
- Circuits from ZAM's to monitored initiating devices: AWG 16 or 14, Violet (+), Grey (-)
- NOTE: Most manufacturers either require or recommend low capacitance, twisted, shielded pair cable for Signaling Line Circuits (addressable loops). All shielded cable must have the grounded "drain" wire maintained continuously around the loop. If unshielded cable was used, verify that the manufacturer's installation instructions require or state a preference for use of unshielded cable. For addressable system retrofit when a non-addressable system had previously been in service, if existing single-conductor wiring from the old system was used (sometimes done if in fine condition, properly color coded, with terminal strips, etc.), verify that the manufacturer's installation instructions do not require the use of twisted pair conductors or low capacitance cable and the installer also agreed to replace the existing fire alarm system wiring if unsatisfactory performance is caused by its re-use (e.g., spurious signals, cross-talk, etc.).

Spares: Provide the following spare parts with the system, each individually packaged and labeled. For multi-building project calculate separately for each building with FACU:

- Fuses (If Used).....2 of each size in system
- Manual Fire Alarm Boxes.....2% of installed quantity
- Addressable Control Relays.....4% of installed quantity
- Indoor Horns/Speakers with Strobes Lights.....4% of installed quantity
- Indoor Strobe-only Notification Appliances.....4% of installed quantity
- Monitor Modules (Addressable Interface).....4% of installed quantity
- Isolation Modules / Isolation Bases.....4% of installed quantity
- Addressable, Electronic Heat Detectors.....4% of installed quantity
- Spot-Type Smoke Detectors / Sounder Bases.....6% of installed quantity

NOTE: Increase decimal quantities of all spare parts to next higher whole number when calculating.

NOTE: No spares are required for projected beam, air sampling, or duct type smoke detectors.

FORM OF PROPOSAL

Campus-Wide HVAC Renovations – Phase 1
NC School of Science & Mathematics
SCO-ID # 24-28565-01A

Contract: Single Prime
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 further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the
State of North Carolina through NC School of Science and Mathematics

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
the Campus-Wide HVAC Renovations in full in complete accordance with the plans, specifications, and contract documents, to the full and entire satisfaction of the State of North Carolina, NC School of Science and Mathematics and McKim & Creed Inc

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(\$)

General Subcontractor:
_____ Lic _____

Plumbing Subcontractor:
_____ Lic _____

Mechanical Subcontractor:
_____ Lic _____

Electrical Subcontractor:
_____ Lic _____

GS143-128(d) requires all single prime bidders to identify their subcontractors for the above subdivisions of work. A contractor whose bid is accepted shall not substitute any person as subcontractor in the place of the subcontractor listed in the original bid, except (i) if the listed subcontractor's bid is later determined by the contractor to be non-responsible or non-responsive or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work, or (ii) with the approval of the awarding authority for good cause shown by the contractor.

ALTERNATES:

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid.

ALT-M1 - Resident Terminal Units: Remove and replace existing VAV and FCU terminal units serving Resident rooms. Include replacement of all associated supply air grilles and thermostats.

_____ Dollars (\$ _____)

ALT-M2 - Other Terminal Units: Remove and replace existing VAV terminal units serving common areas and corridors. Include replacement of all associated supply air grilles and thermostats.

_____ Dollars (\$ _____)

ALT-M3 - Provide BACnet based building automation system by Trane controls as preferred brand alternate.

_____ Dollars (\$ _____)

UNIT PRICES

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the scope of the work all in accordance with the contract documents. Price shall include all labor and material (except where otherwise stated) to furnish and install complete and in working order.

No. 1: Replacement of existing vinyl coated tile (VCT) flooring (specific to areas where floor grilles are being replaced)

Per SF Unit Price (\$) _____/sf

No. 2: Repair existing penetrations in fire rated assemblies (shall include floors and walls).

Per SF Unit Price (\$) _____/sf

ALLOWANCES

Contractor shall include in the base contract sum the following allowances. Unless otherwise stated, the allowances shall include all costs for labor, material, taxes, overhead, profit, fees and associated costs. Costs shall be incorporated in the project by change order in accordance with General and Supplemental Conditions.

Allowance No. 1: Replacement of existing VCT flooring adjacent to floor grilles: 200 SF (square feet)

Allowance No. 2: Repair of existing fire rated penetrations in fire rated assemblies: 200 SF (square feet)

The bidder further proposes and agrees hereby to commence work under the contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions. Applicable liquidated damages amount is also stated in the Supplementary General Conditions.

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 thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

MINORITY BUSINESS PARTICIPATION REQUIREMENTS

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) 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 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

*** OR ***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A **or** Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

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. _____

Email Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 _____ Addendum No. 3 _____ Addendum No. 5 _____ Addendum No. 7 _____

Addendum No. 2 _____ Addendum No. 4 _____ Addendum No. 6 _____ Addendum No. 8 _____

Identification of HUB Certified/ Minority Business Participation

I, _____
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #

Work Type

*Minority
Category

**HUB
Certified
(Y/N)[illegible]

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

The total value of minority business contracting will be (\$)_____.

State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of _____

(Name of Bidder)

Affidavit of _____

I have made a good faith effort to comply under the following areas checked:

Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive. (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted 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 date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made 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 bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject 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.
- ☐ **8 – (25 pts)** Provided 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. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

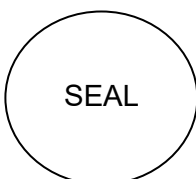
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract with Own Workforce.

County of _____

Affidavit of _____
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the _____
_____ contract.
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

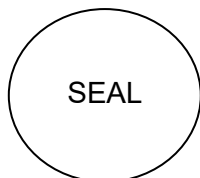
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

(Project Name)
Project ID# _____ Amount of Bid \$ _____

I will expend a minimum of _____ % of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below.

Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

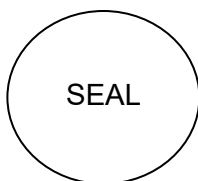
*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____



Signature: _____

Title: _____

State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of _____

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of _____ I do hereby certify that on the _____
(Name of Bidder)

Project ID# _____ (Project Name) Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

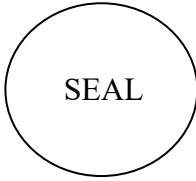
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____



State of _____, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____

My commission expires _____

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
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)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the _____ day of _____ in the year of 20__ by and between _____

hereinafter called the Party of the First Part and the State of North Carolina, through the _____

_____ 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 all of the work in the manner and form as provided by the following enumerated plans, specifications 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; approval of attorney general; certificate by the Office of State Budget and Management, and drawings, titled:

Consisting of the following sheets: _____

Dated: _____ 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 _____ 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 as outlined in Article 14 of the General Conditions of the Contract.

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:

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, 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.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

Contractor: (Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

The State of North Carolina through*

(CORPORATE SEAL)

(Agency, Department or Institution)

Witness:

By: _____

Title: _____

FORM OF PERFORMANCE BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

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)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

FORM OF PAYMENT BOND

Date of Contract: _____

Date of Execution: _____

Name of Principal
(Contractor) _____

Name of Surety: _____

Name of Contracting
Body: _____

Amount of Bond: _____

Project _____

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:

(Proprietorship or Partnership)

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

Contractor: (Trade or Corporate Name)

By: _____

Title _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

**CERTIFICATION BY THE OFFICE OF STATE
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ 20____.

Signed _____
Budget Officer

STATE OF NORTH CAROLINA
COUNTY SALES AND USE TAX REPORT
SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____

Page 1 of _____

PROJECT: _____

FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)

** Must balance with Detail Sheet(s)

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

Sworn to and subscribed before me,

This the _____ day of _____, 20____

Signed

Notary Public

My Commission Expires: _____

Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit.

STATE OF NORTH CAROLINA SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page 2 of

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: _____

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				\$	\$	
				TOTAL:	\$	

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.