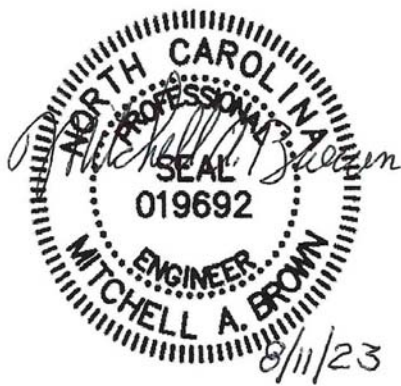


NORTH CAROLINA CORRECTIONAL INSTITUTION FOR WOMEN
NC DEPARTMENT OF ADULT CORRECTION

AIR CONDITIONING INSTALLATION

DATE: August 11, 2023



McKim & Creed, Inc.
1730 Varsity Drive, Suite 500
Raleigh, NC 27606
License # F-1222

McKim & Creed Project Number: 08914-0002

SCO ID No: 22-24913-02A

Code: 42107, Item: 4112

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

Sealed proposals will be received by the North Carolina Department of Adult Correction in Raleigh NC, in the office of NCDPS Central Engineering, Door #4, 2020 Yonkers Road, Raleigh, NC (hand delivered); 4216 Mail Service Center, Raleigh, NC 27699-4216 (mailing address) up to 1:00 PM on September 12, 2023 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of:

NC Correctional Institution For Women– Air Conditioning Installation

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

Complete plans and specifications for this project can be obtained from McKim & Creed, 1730 Varsity Drive, Raleigh, NC 27601 (Contact Mitchell Brown, PE) during normal office hours after August 14, 2023. Plan Deposit for hard copy drawings is \$150.00.

A mandatory pre-bid meeting will be held for all interested bidders on August 30, 2023, at 10:00 AM at NC Correctional Institution For Women, 1034 Bragg Street, Raleigh, NC 27610. The meeting will address project specific questions, security, issues, bidding procedures and bid forms. ***Failure to attend the Pre-Bid Conference will disqualify your company from bidding.***

The meeting is also to identify preferred brand alternates and their performance standards that the owner will consider for approval on this project.

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

NOTICE TO BIDDERS

**NC Department of Adult Corrections
NC Correctional Institution For Women – Air Conditioning Installation
SCO # 22-24913-02A**

Sealed proposals will be received by the North Carolina Department of Adult Correction in Raleigh NC, in the office of NCDPS Central Engineering, Door #4, 2020 Yonkers Road, Raleigh, NC (hand delivered); 4216 Mail Service Center, Raleigh, NC 27699-4216 (mailing address) up to 1:00 PM on September 12, 2023 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of:

NC Correctional Institution For Women – Air Conditioning Installation

The project scope of work includes the installation of air conditioning in three (3) 208 bed dormitories. In each dormitory, the work will include the installation of eight (8) constant volume air handling units with DX cooling coils and hot water heating coils, eight new outdoor air cooled condensing units, refrigerant piping, heating hot water piping, new ductwork and air distribution devices. Each existing dormitory will also be provided with a new direct digital control system for all new and existing equipment. Scope of work may also include adding air conditioning to one 28 bed segregation unit (Single Cell B) and the Auditorium/Gym. The scope of work in Single Cell B and the Auditorium/Gym will be bid as add alternates.

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

Pre-Bid Meeting

A mandatory pre-bid meeting will be held for all interested bidders on August 30, 2023 at 10:00 AM at NC Correctional Institution For Women, 1034 Bragg Street, Raleigh, NC 27610. The meeting will address project specific questions, security, issues, bidding procedures and bid forms. ***Failure to attend the Pre-Bid Conference will disqualify your company from bidding.***

The meeting is also to identify preferred brand alternates and their performance standards that the owner will consider for approval on this project.

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.

In accordance with GS133-3 and SCO procedures the following preferred brand items are being considered as Alternates by the owner for this project:

Add Alt. #3 Preferred Brand for HVAC Controls – Distech ECB Series

Justification of any approvals will be made available to the public in writing no later than seven (7) days prior to bid date.

Complete plans, specifications and contract documents will be open for inspection in the offices of McKim & Creed and in the online plan room of the Associated General Contractors/Reed Construction Data, Carolinas Branch (isqft.com), the online plan room of McGraw-Hill Dodge SCO-Notice To Bidders 2010 – (Updated Dec. 2010)

Corporation (dodge.construction.com), the online plan room at Construct Connect (bidclerk.com) the online plan and in Minority Plan Rooms at

East Coast Digital Planroom., (speedyblue.com) 210 E. 14th St., Suite D, Greenville, NC 27858, 252-758-1616

or may be obtained by those qualified as prime bidders, upon deposit of One Hundred Fifty (\$150.00) in cash or certified check. The full plan deposit will be returned to those bidders provided all documents are returned in good, usable condition within ten (10) days after the bid date.

NOTE: 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.)

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 Unlimited (set forth the license classification required by the NC General Contractors Licensing Board under G.S. 87-1)

NOTE--SINGLE PRIME CONTRACTS: 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. **EXCEPT:** 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 (Plumbing, Mechanical & Electrical) 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 60 days.

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

Designer:

McKim & Creed
1730 Varsity Drive, Raleigh, NC 27606
(919)233-8091

Owner:

NC Department of Adult Correction -
Central Engineering
2020 Yonkers Road, Raleigh, NC 27604
(919)716-3400

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NCCIW Air Conditioning Installation
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FORM OF PROPOSAL

**NC Department of Adult Correction
NCCIW Air Conditioning Installation
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MBE CONTRACTOR LIST AND AFFADAVITS A, B, C & D

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FORM OF PERFORMANCE BOND

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END



GENERAL CONDITIONS

The General Conditions of this Contract Agreement between the “Bidding Contractor” and NCDAC Central Engineering shall follow the State Construction Office North Carolina Department of Administration Form OC-15 Twenty-Fourth Edition dated January 2013 – “Instructions to Bidders and General Conditions of the Contract”.

Form OC-15 Attached within this Document – See next page

**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 INSTRUCTIONS TO BIDDERS AND GENERAL CONDITIONS OF THE CONTRACT

PART 1 - GENERAL CONDITIONS OF THE CONTRACT

1.1 ARTICLE 14 – CONSTRUCTION SUPERVISION AND SCHEDULE

- A. 14.f: If the project is a single prime construction contract, the single prime contractor by default is the project expeditor. See General Conditions Article 1.i.
- B. 14g: Delete the reference to a Bar Chart Schedule. The schedule for this project shall be a CPM Schedule. See Section 01 3200.
- C. 14j: Delete the reference to a Bar Chart Schedule. The schedule for this project shall be a CPM Schedule. See Section 01 3200.

1.2 ARTICLE 23 – TIME FOR COMPLETION, DELAYS, EXTENSIONS OF TIME

- A. Article 23.a: The time for completion of the Work shall be (360) Three Hundred Sixty consecutive calendar days from the date of the Notice to Proceed to Final Acceptance.
- B. Article 23.b: Liquidated damages shall accrue at the rate of (\$500.00) Five Hundred Dollars per day for each calendar day in excess of the number of calendar days designated in Article 23.a.

1.3 ARTICLE 35 – PERFORMANCE BOND AND PAYMENT BOND

- A. If an awarded bid is over three hundred thousand dollars (\$300,000), the 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 provided by the State. An authorized agent of the bonding company who is licensed to do business in North Carolina shall countersign all bonds.

1.4 ARTICLE 38 – USE OF PREMISES

- A. Article 38.d: Contractor shall post a sign indicating Firearms are prohibited on the construction site. See security requirements under Section 01 1100 Security Requirements.

END OF DOCUMENT 00 22 13

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.

NCDAC CENTRAL ENGINEERING SPECIAL CONDITIONS DOCUMENT

PART 1 - SPECIAL CONDITIONS

1.1 DEFINITIONS

- A. The definition of the word "Contractor" used throughout this informal contract agreement is hereby defined as the "Bidding Contractor Installer, Manufacturer, Supplier, Trainer, and Warrantor."
- B. The definition of the word "Subcontractor" used throughout this contract agreement is hereby defined as any third party under contractual agreement with the "Contractor."

1.2 CONFIDENCE IN BID PROPOSAL

- A. It is understood and agreed that, by submitting a bid, the Contractor has examined these contract documents, drawings and specifications and has visited the site of the work and has satisfied himself relative to the work to be performed

1.3 HUB REQUIREMENTS

- A. NCDAC requires that, for construction contracts with a value of \$5000 or greater, the contractor shall comply with the document Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts including Identification of Minority Business Participation, Affidavits A, B, C, and D, and Appendix E.
- B. These forms provided herein are hereby incorporated and made a part of this contract. A bidder's failing to comply with this requirement will be considered non-responsive and will result in bid rejection.
- C. The NCDAC imposed contract threshold of \$5000 for HUB recruitment supersedes any reference to a higher threshold that may be noted in the bid documents, within referenced documents, or within any regulatory requirement.

1.4 SAFETY REQUIREMENTS

- A. The Contractor shall be responsible for the entire site and the building or construction of the same and provide all the necessary protections as required by laws or ordinances governing such conditions and as required for any damage to the Owner's property, or that of others on the job, by himself, or personnel or his contractors, and shall make good such damages.
- B. 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 (Code of Federal Regulations, Part 1926 published in Volume 39, Number 122, Part 11, June 24, 1974, Federal Register), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.
- C. The Contractor shall provide all necessary safety measures for the protection of all persons on the work, 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.

1.5 LIABILITY AND PROPERTY DAMAGE INSURANCE REQUIREMENTS

- A. The Contractor shall not commence work until he has obtained all insurance required, and such insurance has been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been obtained.
- B. The Contractor shall provide and maintain during the life of this contract Workmen's Compensation Insurance, or all employees employed at the site of the project under his contract.
- C. The Contractor shall provide and maintain during the life of this contract such Public Liability and Property Damage Insurance as shall protect him and any subcontractor performing work covered by this contract, from claims for damage for personal injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operation be by the Contractor himself or by any subcontractor, or by anyone directly or indirectly employed by either of them and the amounts of such insurance shall be as follows:
 - 1. Public Liability Insurance in an amount not less than \$300,000 for injuries, including accidental death, to any one person and subject to the same limit for each person, in amount not less than \$500,000 on account of one accident; and Property Damage Insurance in an amount not less than \$100,000/\$300,000.
- D. The Contractor shall furnish such additional insurance as may be required by General Statutes of North Carolina, including motor vehicle insurance in amounts not less than statutory limits.
- E. The insurance certificate, in the "Description and Operations" block, shall identify the following:
 - 1. Job Services Description:
 - 2. NCDAC Job Order Number:
 - 3. NCDAC Contract Number:
- F. Each Certificate of Insurance shall bear the provision that the policy cannot be cancelled, reduced in amount or coverage eliminated in less than thirty (30) days after mailing written notice to the insured and/or the Owner of such alteration or cancellation, sent by registered mail.
 - 1. The North Carolina Attorney General's Office in concurrence with the Department of Insurance has developed the following acceptable and required verbiage concerning the cancellation of insurance coverage.
 - 2. Contractor to provide insurance certificate(s) to this office with language appropriately inserted in the insurance certificate block provided for Special Provisions, as follows: "Notwithstanding the preprinted cancellation provisions on this form, coverages afforded under the policies will not be cancelled, reduced in amount nor will any coverages be 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."
 - 3. This language can be continued on an attached and properly titled continuation sheet as long as the first clause ("Notwithstanding... form,") is on the face of the form or if space will not allow, then at a minimum, insert in the block for Special Provisions, "Cancellation and notice provisions on the attached endorsements control over language on this form." Then attach the required language provided in 2 above.

4. The Contractor shall furnish the Owner with satisfactory proof of carriage of the insurance required before written approval is granted by the Owner.

1.6 APPLICATIONS FOR PAYMENT AND INVOICES

- A. See Section 01 29 00 Payment Procedures.
- B. Final Application for Payment - The Final Payment Application shall be accompanied by the contractor's affidavit. The contractor's affidavit shall state: "This is to certify that all costs of materials, equipment, labor, and all else entering into the accomplishment of this contract, including payrolls, have been paid in full."
- C. Executed contract documents, insurance certification and, upon completion and acceptance of the work, invoices and other information requested are to be sent to:
 1. William Burriola; NCDAC Central Engineering; 2020 Yonkers Road; MSC 4216; Raleigh, NC 27699.
 2. It is imperative that contract documents, invoices, etc., be sent only to this address in order to assure proper and timely delivery and handling.
 3. The Contractor may also email a signed and notarized copies to the PM identified above for processing.

1.7 CONTRACTOR USE OF PROPERTY

- A. Use of Site may be restricted. Work hours are limited to 6:00AM to 6:00PM Monday through Friday. Specific site access requirements will be discussed at the Pre-Bid Meeting.
- B. See Section 01 11 00 - **SECURITY REQUIREMENTS**.

END OF DOCUMENT

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NCCIW Air Conditioning Installation
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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site and Security Requirements.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 01 11 00 "Security Requirements" for use of property, conduct, and other items that affect security at the facility.

1.2 PROJECT INFORMATION

A. Project Identification: NC Correctional Institution For Women Air Conditioning Installation; SCO # 22-24913; NCDAC JOS # 4290.

1. Project Location: NC Correctional Institution For Women 1034 Bragg Street, Raleigh NC 27610.

B. Owner: North Carolina Department of Adult Correction; 512 North Salisbury Street, Raleigh, NC 27604.

C. Architect/Engineer: McKim & Creed, 1730 Varsity Road, Raleigh, NC 27606.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. This project involves the installation of air conditioning in two dormitories and in possibly three additional buildings at the correctional institution. The work includes mechanical and electrical work, fencing, concrete work, and other Work as indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract

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or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1.5 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations.
- 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. Driveways, Walkways, and Entrances: Keep driveways 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 for storage of materials.
- C. See the requirement in Section 01 11 00 "Security Requirements."

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site, existing, and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Final Acceptance of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
- C. See the requirement in Section 01 11 00 "Security Requirements."

1.7 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.
 - 2. See the requirement in Section 01 11 00 "Security Requirements."
- 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. See the requirement in Section 01 11 00 "Security Requirements."
- C. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted. See the requirement in Section 01 1100 "Security Requirements."

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1.8 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 01 1100 - SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes North Carolina Department of Adult Correction (NCDAC) Security Requirements for Contractors while working on NCDAC property.
- B. The purpose of this document is to provide SECURITY requirements for the Contractor and his Subcontractors. Depending on the scope of work and location not all rules may apply. At the pre-construction conference these requirements will be reviewed.
- C. Related Requirements:
 - 1. Division 01 Section "01 5000" for Temporary Facilities and Controls.

1.2 SECURITY CLEARANCE AND REQUIREMENTS

- A. Security Clearance - All persons entering a North Carolina Department of Adult Correction (NCDAC) property MUST provide and executed "Contractor NC Department of Adult Correction Criminal History Record Check Form HR 004" and receive approval for entry.
 - 1. At least seven days prior to their appearance at the DPS facility to start work, the Contractor is requested to provide in writing on the "NC Department of Adult Correction Criminal History Record Check Form HR 004," the following information for all crew members and supervisors who will be working on this project at the site. including subcontractors and their personnel; employee's name, Social Security number and driver's license number. The NCDAC will perform, or have performed, a security check of the prospective Contractor employee. If the Contractor is informed that any of these persons are declared undesirable by the NCDAC, this person will not be allowed to work on this construction project. The NCDAC reserves the right to deny entry to any employee of the Contractor or his subcontractors, if the NCDAC feels security of the facility will be compromised in any way. Every person entering the NCDAC facility will be required to present photo identification every time they enter and leave the facility.
 - 2. The "NC Department of Adult Correction Criminal History Record Check Form HR 004," is located immediately following this Section.
 - 3. The NCDAC project manager will provide the awarded contractor with contact and transmittal information specific to the facility where the work will be conducted. The facility will assign one point of contact to receive, process and notify all parties of security clearances. The contractor shall transmit completed HR 004 forms only to the facility contact provided by the NCDAC project manager.

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- B. Security Requirements - All persons entering a NCDAC property must thoroughly read this Section, understand the content, and sign the “Signature Form”. It is the responsibility of the Supervisor for the Contractor to ensure that this document is read and understood, that signatures are obtained, and that copies are maintained at the job site at all times. Signatures are required for Contractor and their Subcontractor's supervision and employees who enter the NCDAC property.
 - 1. “Signature Form” is located at the end of this Section.

1.3 ASSIGNED REPRESENTATIVES

- A. Assigned Contractor Representative - The Supervisor for the Contractor, (to be named at pre-construction conference) is to act as spokesperson and liaison between the Contractor and the North Carolina Department of Adult Correction, here-in-after referred to as the NCDAC.
- B. NCDAC Representative – This representative will be named at pre-construction conference and will be the on-site NCDAC representative for this project.
- C. Communications - All communications regarding security between the Contractor and the NCDAC are to be handled through these representatives. This NCDAC representative or his designee will be responsible for contacting the Superintendent or the Assistant Superintendent of the NCDAC facility, concerning operations and security issues as they relate to the performance of this project.
 - 1. The Contractor shall submit to the designated NCDAC representative at his earliest convenience the name of the Job Superintendent and a responsible person or contact in the home office. A general crew number size should be provided to the NCDAC representative and notification should be given if the crew size will fluctuate by a large amount during any special work period.
 - 2. Anytime any Subcontractor is on site, the Contractor must provide supervision.
- D. The Designer is to be contacted for all other inquires relating to the contract and contract documents, i.e., drawings and specifications.

1.4 CONDUCT REQUIREMENTS

- A. Roaming around the NCDAC property is not permitted and may result in that person being escorted from the site and revocation of the security clearance.
- B. All Contractor personnel are expected to observe proper conduct on the job site. Indecent language, acts or dress will not be tolerated. Shirts are required at all times. Anyone guilty of such violations will be immediately removed from the property.
- C. The Contractor is reminded that no food or canteen type items will be available to construction personnel through the NCDAC.

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- D. Contractor is reminded that any dealings with the media or press while on site shall be approved or otherwise addressed by the NCDAC representative or his designee.
- E. Noise must be kept minimal or as reasonably achievable.
- F. Contraband - The Contractor is instructed that it is a violation of North Carolina law to allow any person to bring firearms, alcoholic beverages of any type, or drugs other than those prescribed by a doctor onto the premises including the parking lot of a NCDAC property.
- G. Inmate Fraternization - The Contractor is instructed that no construction personnel are to communicate in any way with inmate personnel of the facility. Construction personnel are also requested to remain within the construction area at all times during working hours. Communication with inmate personnel” shall include but not be limited to the following:
 - 1. Borrowing from or lending anything to an offender
 - 2. Accept any gift/personal service from an offender, unless authorized by law, or give gifts or personal service
 - 3. Tip an offender
 - 4. Sell or give any offender any intoxicating drink, barbiturate or stimulant drug, or any narcotic, poison or poisonous substance, except upon the prescription of a physician and approval of the Superintendent or designee
 - 5. Convey to or from an offender any letters or oral messages or any instrument or weapon by which to affect an escape, or that will aid in an assault or riot
 - 6. Trade with an offender for clothing or stolen goods
 - 7. Sell to an offender any article forbidden by Division of Prisons
 - 8. Use abusive, indecent or profane language, or profane gestures, in the presence of an offender
 - 9. Curse an offender
 - 10. Knowingly make or maintain contact with or in any way associate with a member of an offender’s family or close associates, unless duties so require or authorization to do so have been obtained by the Division Director or designee
 - 11. Engage in sexual relations of any kind with an offender
 - 12. Knowingly enter into a business relationship with an offender or their family member of close associate
- H. Smoking - Smoking is prohibited on the campus of any NCDAC facility.
- I. Tool Control - The Contractor will be responsible for control and accountability of all of his tools, equipment, and materials of construction.
 - 1. As few tools as possible to accomplish the required work should be brought into the NCDAC facility.
 - 2. Some of the Contractor's tools may be subject to special restrictions such as all cordless powder activated tools and tools classified by the NCDAC as *hazardous or Class “A”*. The Contractor should control those tools carefully,

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and account for them daily, and remove them, or secure them to the satisfaction of the NCDAC Representative at the end of each working day.

a. Class "A" tools are tools that can be used by inmates either in effecting an escape or in causing serious injury or death to either staff, visitors, or other inmates and include, but are not limited to:

- 1) Ladders
- 2) Jacks
- 3) Hacksaw Blades
- 4) Pipe Wrenches
- 5) Knives
- 6) Metal Cutting Equipment
- 7) Wire Cutters
- 8) Files
- 9) Cutting Torches and Cutting Tips
- 10) Pipe Cutters and Bolt Cutters
- 11) Axes/Emery Wheels and Drill Bits
- 12) Portable Grinders or Similar Machines

3. The NCDAC reserves the right to request all tools be removed at the completion of each workday. A list of tools classified as hazardous or Class A is attached See the NCDAC site representative for further requirements.

J. Photography - The Contractor so desiring may take progress pictures of construction; however, the Contractor is warned that to photograph an inmate of a correctional facility without permission is a violation of North Carolina law.

K. Vehicle Keys - Vehicle keys for Contractor's vehicles parked within the facility shall be housed at the Gate House or officer station at the entrance or area designated by the NCDAC representative. Vehicles or equipment frequently moved within the facility for the performance of work shall have the keys stored at an approved location under NCDAC Custody control when the vehicle is not in use.

1.5 WORKING HOURS

A. A definite consistent time pattern of working days and hours is to be established and agreed upon between the Contractor and the NCDAC facility consistent with the contract. In the event that a job condition requires a variation of these hours on a day-to-day basis, or work on a weekend, it is requested that the Contractor notify the NCDAC site representative of the necessary change in working hours as far in advance as practical. The NCDAC reserves the right to deny a variation of the standard work hours and especially a Contractor's request to work on a weekend may be subject to be denied.

1.6 USE OF PROPERTY

A. The site is to be organized and debris minimized. It is important that all construction debris be controlled and kept from any area accessible to an inmate unless it is under

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direct and constant observation. Any spills of chemicals or fuel by the Contractor will be his to clean and properly dispose of. The Contractor is required to report any spills to the NCDAC.

- B. The Contractor shall notify the NCDAC of any hazardous materials / chemicals to be brought on site.
- C. Storage and Staging Areas - On-site storage is limited and shall be allocated, and approved by the NCDAC Site representative at the beginning of the job.
 - 1. The Contractor shall use extreme caution when moving equipment in or out of the project site and buildings and shall coordinate these activities with the NCDAC Site Representative.
 - 2. Absolutely no shipments of materials, etc., will be received or cared for by any NCDAC personnel at the facility. Shipments coming into the site after working hours will not be received and will be sent back for delivery the next working day.
- D. Existing Drives, Parking, and Roadways - The driveways and roadways around the property are not to be blocked completely at any time during the course of the project. Keep streets clean, free of mud and debris on a timely basis. Any blockage of streets or roadways is to be coordinated with the NCDAC.
 - 1. Unless otherwise addressed by an approved contract, damage to sidewalks, driveways, or other conveyance, and underground utilities, will be the responsibility of the Contractor to repair.
 - 2. A specific parking area will be set aside for the construction personnel and the Contractor must assist in enforcing that all construction personnel park within this area. All vehicles must be locked at all times and no keys left in any vehicle at any time.
- E. Toilet Facilities - The Contractor and the NCDAC representative will establish appropriate restroom usage protocol for the contractor's staff while on site.
- F. Utility Disruptions - Site emergency water cut-off locations are available upon request. Utility disruptions required by the job shall be coordinated with the NCDAC before the disruption at least 48 hours in advance. Special circumstances may require this notification to be extended.
 - 1. The Contractor is responsible for the repair of any utility or service disturbed or disconnected.
 - 2. Restoration of utility service is expected within the same day unless alternate arrangements have been accepted by the NCDAC.
- G. Temporary Controls - The Contractor will use orange mesh fencing or other approved means to segregate and control the work area.

PART 2 - PRODUCTS

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PART 3 - EXECUTION

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Signature Page (See Article 1.2.B)

SIGNATURES: To be signed after reading, or receiving an explanation, of the above security rules.
(Note 1.):

Contractor Supervisor: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____
Crew Member: _____ Date: _____

Notes:

1. Required for Contractor and their Subcontractor's supervision and employees who enter the NCDAC facility. Copy this signature sheet as required.

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END OF SECTION 01 1100



**NC Department of Public Safety
Criminal History Record Check**

Section I (To be completed by Manager or designee)

Division _____ Section _____
 Manager Name _____ Phone # _____
 Employment Intern
 Investigation Volunteer

Section II (Completed by Applicant/Employee)

Information is used for criminal history verification purposes. Only authorized employees and hiring authorities have access to submitted information.

Full Name Last _____ First _____ Middle _____
 Maiden _____ ALL previously used last names _____
 Race/Ethnic Origin _____ Description of "Other" _____
 Date of Birth _____ Full SSN _____ Driver's License State _____ Number _____
 Place of Birth City _____ State _____ High School City _____ State _____
 Female Male Height Feet _____ Inches _____ Weight _____ Color of Hair _____ Eyes _____
 List/describe all scars/tattoos/marks (If none, enter N/A) _____

Have you ever been employed by NCDPS/Division of (Check all that apply and complete items below) : AC/JJ Admin. LE
 No Yes If "Yes," enter dates: Start _____ End _____
 No Yes If "Yes," enter dates: Start _____ End _____

NOTE: Enter **CURRENT ADDRESS** in the first line of the table below. If you have lived at your "Current Address" for less than five (5) years, you **must** enter all previous addresses to cover a minimum of five (5) years. If additional space is required, enter the information on the back of this form.

Street	City	State	Zip	County

I verify that the information provided is true, accurate and complete to the best of my knowledge.

Signature _____ Date _____

Section III (DCI Operator Use Only)

Date of Request _____ Possible Record Pending Unserved Disposed
 Clean Record - No convictions / No traffic violations
 Clean Record other than Minor traffic violations (list below).

 DCI Operator's Name _____

 SID # _____ FBI# _____
 Date DCI Completed _____

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SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost for each alternate is the net addition to the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Provide all work indicated on drawings for Single Cell B.
- B. Alternate No. 1: Provide all work indicated on the drawings for Auditorium/Gym.
- C. Owner Preferred Alternate No. 3: Provide all building automation controls by Distech ECB Series.

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END OF SECTION 01 23 00

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SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.

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- f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

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1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 2 - EXECUTION (Not Used)

END OF SECTION 01 2500

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SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions (ASI) authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on form included in Project Manual or the Architect's office standard if not included.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

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2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, the Architect will issue a Change Order through InterScope+ for approval by the Contractor, the Owner, and the SCO. The final Change Order will be on the Change Order Form included in Project Manual or on the NC SCO Website if not included. All Change Orders are processed through the SCO InterScope+ system.

1.5 CONSTRUCTION FIELD ORDER

- A. Construction Field Order: Architect may issue a Construction Field Order. Construction Field Order instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Field Orders contain a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time. Form of Construction Field Order shall be as included in the Project Manual or on the NC SCO Website if not included.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Field Order.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

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SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. *NCDAC may secure the Work of this contract under several project delivery methods. If the Owner Representative is designated during the Pre-Bid Conference as a Project Manager (Internal Design), the Payment Applications and Schedule of Values shall be submitted to that assigned Project Manager. Otherwise, these documents shall be submitted to the Architect.*
- C. Use forms listed herein. Should the forms not be listed by name, use either the forms contained in this project manual or on the NC SCO website. If the forms are neither listed herein or contained in this manual, use forms that are required by the State of North Carolina State Construction Office.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of AIA Document G703.
 - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 - 3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 - 4. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.

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5. Closeout Costs: Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
6. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Field Order result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Field Order.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the fifth (5th) of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Field Orders issued before last day of construction period covered by application.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. State of North Carolina County Sales and Use Tax Report: With each Application for Payment, submit both the Summary Totals and Certification Sheet and the back-up

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Sales and Use Tax Detail Sheet. Use the form at the end of this Section or, if not located at the end of this Section, that is available on the SCO website.

- H. Waivers of Mechanic's Lien: With the Final Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Schedule of unit prices if unit prices are used.
 6. Submittal schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Documentation required under Section 01 1100 Security Requirements.
- J. Application for Payment at Final Completion: Submit an Application for Payment showing 100 percent completion for portion of the Work claimed as complete.
1. Include documentation supporting claim that the Work is complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Beneficial Occupancies issued previously for Owner occupancy of designated portions of the Work.
 3. Evidence of completion of Project closeout requirements.
 4. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 5. Updated final statement, accounting for final changes to the Contract Sum.

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6. Contractor's Affidavit of Payment of Debts and Claims – SCO Form. Form is at the end of this section or as located on the SCO Website.
7. Affidavit of Release of Lien – SCO Form. Form is at the end of this section or as located on the SCO Website.
8. Consent of Surety for Final Payment when Performance and Payment Bonds have been provided - SCO Form. Form is at the end of this section or as located on the SCO Website.
9. Evidence that claims have been settled.
10. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Final Acceptance or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
11. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
- C. Project Managers
 - 1. The North Carolina Department of Adult Correction Central Engineering frequently uses in-house staff – Project Managers - to manage projects. These managers serve as expeditors and facilitate communications and processes during all phases of a project. When a Project Manager is assigned to a project, the contractor will be notified prior to bidding and all correspondence and project related issues must be conducted through that assigned Project Manager.

1.2 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Architect, Project Manager, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect (through the Project Manager when applicable) indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: DWG, operating in Microsoft Windows operating system.
 - 2. File Submittal Format: Submit or post coordination drawing files using PDF format.
 - 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Bluebeam Revu.

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- c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return without response those RFIs submitted to Architect (through the Project Manager when applicable) by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Form bound in Project Manual or as approved by the Architect if not bound herein .
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect (through the Project Manager when applicable) after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.

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- d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect (through the Project Manager when applicable) of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect (through the Project Manager when applicable) in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action (through the Project Manager when applicable) , update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect (through the Project Manager as appropriate) within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will not provide Architect's CAD drawing digital data files for Contractor's use during construction. However, the Contractor may obtain .PDF files for use as described below.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in Bluebeam Revu format.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

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1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
- B. Preconstruction Conference: Architect (through the Project Manager when applicable) will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner Architect, and Project Manager (when applicable) and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Security requirements.
 - c. Tentative construction schedule.
 - d. Phasing.
 - e. Critical work sequencing and long lead items.
 - f. Designation of key personnel and their duties.
 - g. Lines of communications.
 - h. Use of web-based Project software.
 - i. Procedures for processing field decisions and Change Orders.
 - j. Procedures for RFIs.
 - k. Procedures for testing and inspecting.
 - l. Procedures for processing Applications for Payment.
 - m. Distribution of the Contract Documents.
 - n. Submittal procedures.
 - o. Sustainable design requirements.
 - p. Preparation of Record Documents.
 - q. Use of the premises and existing building(s) as applicable.
 - r. Work restrictions.
 - s. Working hours.
 - t. Owner's occupancy requirements.
 - u. Responsibility for temporary facilities and controls.
 - v. Procedures for moisture and mold control.

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- w. Procedures for disruptions and shutdowns.
 - x. Construction waste management and recycling.
 - y. Parking availability.
 - z. Office, work, and storage areas.
 - aa. Equipment deliveries and priorities.
 - bb. First aid.
 - cc. Security.
 - dd. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Sustainable Design Requirements Coordination Conference (when applicable): Owner will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner, Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, Project Manager (when applicable) and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:
 - a. Sustainable design Project checklist.
 - b. General requirements for sustainable design-related procurement and documentation.
 - c. Project closeout requirements and sustainable design certification procedures.
 - d. Role of sustainable design coordinator.
 - e. Construction waste management.
 - f. Construction operations and sustainable design requirements and restrictions.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect (through the Project Manager when applicable) of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.

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- b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Progress Meetings: Conduct progress meetings at regular intervals but not less than once per month.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Security requirements.
 - 4) Resolution of component conflicts.
 - 5) Status of submittals.
 - 6) Status of sustainable design documentation.
 - 7) Deliveries.
 - 8) Off-site fabrication.
 - 9) Access.
 - 10) Site use.
 - 11) Temporary facilities and controls.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of correction of deficient items.
 - 15) Field observations.
 - 16) Status of RFIs.
 - 17) Status of Proposal Requests.
 - 18) Pending changes.
 - 19) Status of Change Orders.
 - 20) Pending claims and disputes.
 - 21) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Construction schedule updating reports.
 - 3. Daily construction reports.
 - 4. Site condition reports.
- B. Related Requirements:
 - 1. Section 01 1100 "Security Requirements" for additional requirements.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

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1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. For construction contracts \$450,000.00 and above, the Construction Schedule shall be a CPM Schedule. For construction contracts less than \$450,000.00, the Construction Schedule shall either be a Bare/Gantt Chart Type Schedule or a CPM-Type Schedule at Contractor's option.
- B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

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- C. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Acceptance.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 - 6. Beneficial Occupancy: In cases where Beneficial Occupancy is required by the Owner, indicate completion in advance of date established for Beneficial Occupancy, and allow time for Architect's/Project Manager's administrative procedures necessary for Beneficial Occupancy.
 - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 - 3. Work Restrictions: Show the effect of the following items on the schedule. Carefully coordinate with Section 01 1100 "Security Requirements" for access to, and use of, the facilities:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Final Completion (Beneficial Occupancy).
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.

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- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Beneficial Occupancy, and Final Completion.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect/Project Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.6 BAR/GANTT CHART SCHEDULE REQUIREMENTS

- A. Bar/Gantt Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 15 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

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1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.7 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 15 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.

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- j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.

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2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.8 REPORTS

- A. Coordinate requirement in this Article with any additional requirement contained in Section 01 1100 "Security Requirements."
- B. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Field Orders received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
- A. Weekly Construction Progress Report: Prepare a weekly construction progress report recording the following information at a minimum and submit it at the end of each week:
 1. Progress of the work over the week listing items of work performed.
 2. The percent complete of construction.
 3. Projected work summary for the upcoming week.
 4. Any issues that require guidance from the Designer or the Owner.

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5. Photographic documentation of the progress of the work in sufficient detail to reflect the stated percentage completeness of the work.

- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3200

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Submittal schedule requirements.
 2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.

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11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: *Identify options requiring selection by Architect.*
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number followed by the name of the specification section.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect or as *SCO ID # - Specification Section # - Three-word description of the content of the submittal.*
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Note that the product data portion of all submittals, when submitted concurrently with samples that require a finish selection, will be returned with the appropriate Action stamp but the exact finish selection will not be made and forwarded until all samples requiring a finish selection are obtained, reviewed, and the selections are coordinated. The Contractor is responsible for timely submission to ensure this process is completed in adequate time to ensure that

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all materials are obtained in adequate time to incorporate into the Work and not delay the project schedule.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Resubmittal Review: Allow 15 calendar days for review of each resubmittal.
 - 3. Please note that these processing times do not necessarily include processing time required by the NC SCO for submittals requiring NC SCO review. These submittals typically include any delegated design. Allow 22 calendar days for the initial and resubmittal reviews.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. *Mark each copy of each submittal to show which products and options are applicable.*
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.

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- g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before, or concurrent with, Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal is based on Architect's digital data drawing files is otherwise permitted. The contractor must provide a signed Electronic Release Form obtained from Central Engineering or the design professional as appropriate to utilize electronic files.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials. *Samples are required to be submitted by physical samples and not PDF electronic files.*
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

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- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

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G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

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- a. Name of evaluation organization.
- b. Date of evaluation.
- c. Time period when report is in effect.
- d. Product and manufacturers' names.
- e. Description of product.
- f. Test procedures and results.
- g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect *will not review* submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.

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- B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Architect will return without review submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

SECTION 01 3516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

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1.3 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
 - 1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Fire-prevention plan.
 - b. Governing regulations.
 - c. Areas where existing construction is to remain and the required protection.
 - d. Hauling routes.
 - e. Sequence of alteration work operations.
 - f. Storage, protection, and accounting for salvaged and specially fabricated items.
 - g. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - 3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at monthly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - 2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.4 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1.5 INFORMATIONAL SUBMITTALS

- A. Alteration Work Program: Submit 30 days before work begins.
- B. Fire-Prevention Plan: Submit 30 days before work begins.

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1.6 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.7 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site.
 - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
 - 1. Repair and clean items for reuse as indicated.
 - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

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- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
 - 1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 - 2. Secure stored materials to protect from theft.
 - 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

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- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection as appropriate to prevent damage to existing roof materials.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
 - 1. Comply with NFPA 241 requirements unless otherwise indicated.
 - 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
 - 1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.

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2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.
- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that

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are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings.
- B. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- C. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 01 3516

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not

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Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.
 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

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1.4 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- C. **All work shall be in strict compliance with all governing building codes and standards.**

1.5 ACTION SUBMITTALS

- A. **Delegated-Design Services Submittal:** In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 INFORMATIONAL SUBMITTALS

- A. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. **Testing Agency Qualifications:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. **Permits, Licenses, and Certificates:** For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar

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documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Statement on condition of substrates and their acceptability for installation of product.
 2. Statement that products at Project site comply with requirements.
 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Statement that equipment complies with requirements.
 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to

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inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 8. Demolish and remove mockups when directed unless otherwise indicated.

- L. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are the Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspection requested by Contractor and not required by the Contract Documents are the Contractor's responsibility.
 - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority (when applicable) and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect, Commissioning Authority (when applicable), and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

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5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."
- F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. **Associated Contractor Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspection equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. **Special Tests and Inspections:** The Owner will engage a qualified testing agency special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached (or as required by the NC Building Code if not attached) to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

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2. Notifying Architect, Commissioning Authority (when applicable), and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority (when applicable) with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Final Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's (when applicable), reference during normal working hours.
 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

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SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

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- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 12. AGA - American Gas Association; www.aga.org.
 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 16. AIA - American Institute of Architects (The); www.aia.org.
 17. AISC - American Institute of Steel Construction; www.aisc.org.

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18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.;
www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers);
www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada;
www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association;
www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>.
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.;
www.chemicalfabricsandfilm.com.

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54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association;
www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csagroup.com.
65. CSA - CSA International; www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute);
www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association;
www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.

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93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; www.iccsafe.org.
102. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
103. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
104. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEC - International Electrotechnical Commission; www.iec.ch.
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
110. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
111. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
112. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISO - International Organization for Standardization; www.iso.org.
118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; www.itu.int/home.
120. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; www.lightning.org.
123. MBMA - Metal Building Manufacturers Association; www.mbma.com.
124. MCA - Metal Construction Association; www.metalconstruction.org.
125. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
126. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
127. MHIA - Material Handling Industry of America; www.mhia.org.
128. MIA - Marble Institute of America; www.marble-institute.com.

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129. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
130. MPI - Master Painters Institute; www.paintinfo.com.
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
132. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
133. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
134. NADCA - National Air Duct Cleaners Association; www.nadca.com.
135. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
136. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
137. NBI - New Buildings Institute; www.newbuildings.org.
138. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
139. NCMA - National Concrete Masonry Association; www.ncma.org.
140. NEBB - National Environmental Balancing Bureau; www.nebb.org.
141. NECA - National Electrical Contractors Association; www.necanet.org.
142. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
143. NEMA - National Electrical Manufacturers Association; www.nema.org.
144. NETA - InterNational Electrical Testing Association; www.netaworld.org.
145. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - National Fire Protection Association; www.nfpa.org.
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; www.nfrc.org.
149. NHLA - National Hardwood Lumber Association; www.nhla.com.
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
153. NRCA - National Roofing Contractors Association; www.nrca.net.
154. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
155. NSF - NSF International; www.nsf.org.
156. NSPE - National Society of Professional Engineers; www.nspe.org.
157. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
159. NWFA - National Wood Flooring Association; www.nwfa.org.
160. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PDI - Plumbing & Drainage Institute; www.pdionline.org.
162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
163. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
164. RFCI - Resilient Floor Covering Institute; www.rfci.com.
165. RIS - Redwood Inspection Service; www.redwoodinspection.com.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.

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168. SDI - Steel Deck Institute; www.sdi.org.
169. SDI - Steel Door Institute; www.steeldoor.org.
170. SEFA - Scientific Equipment and Furniture Association (The);
www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; www.siaonline.org.
173. SJI - Steel Joist Institute; www.steeljoist.org.
174. SMA - Screen Manufacturers Association; www.smainfo.org.
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
178. SPIB - Southern Pine Inspection Bureau; www.spib.org.
179. SPRI - Single Ply Roofing Industry; www.spri.org.
180. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
181. SSINA - Specialty Steel Industry of North America; www.ssina.com.
182. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
183. STI - Steel Tank Institute; www.steeltank.com.
184. SWI - Steel Window Institute; www.steelwindows.com.
185. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
187. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance);
www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; www.masonrysociety.org.
192. TPI - Truss Plate Institute; www.tpinst.org.
193. TPI - Turfgrass Producers International; www.turfgrassod.org.
194. TRI - Tile Roofing Institute; www.tilerroofing.org.
195. UL - Underwriters Laboratories Inc.; www.ul.com.
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
198. USGBC - U.S. Green Building Council; www.usgbc.org.
199. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
200. WA - Wallcoverings Association; www.wallcoverings.org.
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

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- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.

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2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. NC SCO; North Carolina State Construction Office; <https://ncadmin.nc.gov/businesses/construction>
 7. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 8. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

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SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 01 1100 "Security Requirements" Requirements for use of property during construction and special provisions for conduct and utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated in other Sections. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: If needed for the project or if designated in other Sections, use prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: If needed for the project or if designated in other Sections, the Field Office shall be of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

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2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
- B. Work closely with the institution to determine the location of temporary facilities, separation of construction operations from the existing institution including fencing, site access protocols, etc.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers to municipal system or private system indicated as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity.

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Select equipment that will not have a harmful effect on completed installations or elements being installed.

- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service overhead unless otherwise indicated.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Final Completion inspection. Remove before Final Inspection. Personnel remaining after Final Inspection will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as required and as agreed upon at a Pre-Construction Meeting. See Section 01 1100.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary or use designated areas of Owner's existing parking areas for construction personnel as agreed upon at the Pre-Construction Meeting. See Section 01 1100.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

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1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 7300 "Execution."
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- D. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
- E. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.

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3. Provide walk-off mats at each entrance through temporary partition.
- F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses as required for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Acceptance.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than the Final Inspection. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Prior to the Final Inspection, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

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SECTION 01 6000 - 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.
- B. Related Requirements:
 - 1. Section 01 2500 "Substitution Procedures" for requests for substitutions.

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 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 single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 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.

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1.4 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. Coordinate with the requirements of Section 01 11100 "Security Requirements" and the security requirements at the institution.
- C. 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.
- D. 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.

1.5 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.

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- 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.

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 meeting 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.
- B. Product Selection Procedures:
 - 1. Limited List of Products: 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.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 - 2. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
 - 3. Limited List of Manufacturers: 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.

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- a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
 4. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
 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.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures."
- 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 in Section 01 2500 "Substitution Procedures" for proposal of 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 meeting the parameters of Comparable Products: Comparable Products must be comparable in every way to the "Basis-of-Design" product as evidenced by testing and product data as determined when reviewed by the Architect. The burden of proof of being comparable is on the Contractor. If the architect determines that the product is not comparable and/or if the following conditions are not satisfied, Architect will not accept the product as being a Comparable Project and will return any submittals without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed

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comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.

2. Evidence that proposed product provides specified warranty.
3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
4. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

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SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Installation of the Work.
 - 2. Cutting and patching.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protection of installed construction.

- B. Related Requirements:
 - 1. Section 01 1000 "Summary" for limits on use of Project site.
 - 2. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

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PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

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3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "Project Management and Coordination."

3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Final Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.

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- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Remove and replace damaged, defective, or non-conforming Work.

3.4 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 1000 "Summary."

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- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.

- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

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3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Final Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 5000 "Temporary Facilities and Controls."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Final Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

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- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Final Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 7300

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SECTION 01 7700 - 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. Beneficial Occupancy (Partial Utilization) procedures.
 - 2. Final Inspection procedures.
 - 3. Final Completion procedures.
 - 4. Warranties.
 - 5. Final cleaning.
 - 6. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 7823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 7839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Beneficial Occupancy - Contractor's List of Incomplete Items and documentation that all life-safety systems are fully operational.
- C. Final Inspection – Letter from the Contractor that all items are complete and that the project is ready for the Preliminary Final Inspection.

1.3 CLOSEOUT DOCUMENTS

- A. Signed Final Inspection Checklist.
- B. Unsettled Claim Verification – Certification that no unsettled claims exist on the project.
- C. Record Drawings.
- D. Record Project Manual.
- E. Final Payment Application Submission.
 - 1. Final Payment Application
 - 2. Minority Business Enterprise Final Documentation
 - 3. Consent of Surety of Final Payment – SCO form
 - 4. Contractor's Affidavit of Release of Liens – SCO form

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- 5. Contractor's Affidavit of Payment of Debts and Claims – SCO form
- F. Certificates of Release: From authorities having jurisdiction.
- G. Certificate of Insurance: For continuing coverage.
- H. Field Report: For pest control inspection.

1.4 FINAL INSPECTION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Preliminary Final Inspection: Complete the following a minimum of 10 days prior to requesting inspection. List items below that are incomplete at time of request.
 - 1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - 4. Submit testing, adjusting, and balancing records.
 - 5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Preliminary Final Inspection: Complete the following a minimum of 10 days prior to requesting inspection. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Complete startup and testing of systems and equipment.
 - 3. Perform preventive maintenance on equipment used.
 - 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 7900 "Demonstration and Training."
 - 5. Advise Owner of changeover in utility services.
 - 6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 8. Complete final cleaning requirements.

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9. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection a minimum of 10 days prior to date the Work will be completed and ready for Preliminary Final Inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.

1.5 FINAL INSPECTION PROCEDURES

- A. Submittals Prior to Final Inspection: Before requesting final inspection for determining Final Completion, complete the following:
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
 3. Certified List of Incomplete Items: Submit certified copy of Architect's inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 4. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements. Please note that any Builder's Risk policies must remain in effect until the date of Final Completion of the project.
 5. Submit pest-control final inspection report.
- B. Procedures Prior to Final Inspection: Complete the following a minimum of 10 days prior to requesting Final Inspection. List items below that are incomplete at time of request.
1. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
- C. Final Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. This inspection will be used in determining a date of Final Completion provided all work is complete. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction

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including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Final Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit on digital media acceptable to Architect.
- D. Warranties in Paper Form:
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

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. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Beneficial Occupancy or for the Final Inspection for entire Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - c. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Sweep concrete floors broom clean in unoccupied spaces.
 - e. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - f. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - g. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - h. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - i. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 5000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations, before requesting inspection for determination of Final Completion.

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- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, 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.

END OF SECTION 01 7700

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SECTION 01 7823 - 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 manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority (when applicable) will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
 - 2. Submit three paper copies. Architect will return two copies.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for the Preliminary Final Inspection and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority (when applicable) will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's (when applicable) comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's (when applicable) comments and prior to commencing demonstration and training.
- D. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

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1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. 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: Bookmark 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.

- B. 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.
 - 2. 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.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: 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.

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5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. 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.
- 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. 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."

1.5 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.
- 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.

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- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

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SECTION 01 7839 - 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.
- B. Related Requirements:
 - 1. Section 01 7300 "Execution" for final property survey.
 - 2. Section 01 7823 "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 one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one of file prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and two set(s) of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit one copy of annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories 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.

1.3 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.

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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.
 - e. Cross-reference record prints to corresponding photographic documentation.
 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. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Field Order.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. 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 Field Order numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before Preliminary Final Inspection, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.

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4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 3100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Format: Annotated PDF electronic file with comment function enabled.
 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.4 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 annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- 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.

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- B. 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.

- C. Format: Submit record Product Data as annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents 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.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 7839

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SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 01 7823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 4000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination."

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1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.

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- b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

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1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on CD-ROM or thumb drive.
- B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

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- D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 7900

SECTION 01 9113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

[Edit this to remove any Sections referenced that include systems that are not being commissioned.](#)

1. Section 01 1000 "Summary" for Commissioning Authority responsibilities.
2. Section 01 3300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
3. Section 01 7700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
4. Section 01 7823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
5. Section 01 9119.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.
6. Section 21 0800 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
7. Section 22 0800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
8. Section 23 0800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
9. Section 26 0800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.
10. Section 27 0800 "Commissioning of Communications" for technical commissioning requirements for communications systems.
11. Section 28 0800 "Commissioning of Electronic Safety and Security" for technical commissioning requirements for electronic safety and security systems.

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1.2 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- B. Basis-of-Design Document: A document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- C. Commissioning Authority: An entity engaged by Owner and identified to evaluate Commissioning-Process Work.
- D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.
- E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.
- F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved.
 - 1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
 - a. Completion of tests and acceptance of test results.
 - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
 - c. Comply with requirements in Section 01 7900 "Demonstration and Training."
 - d. Completion and acceptance of submittals and reports.
- G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.

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- H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.3 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 01 3300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.
- B. Commissioning Plan Information:
 - 1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
 - 2. Schedule of commissioning activities integrated with the Construction Schedule. Comply with requirements in Section 01 3200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
 - 3. Contractor personnel and subcontractors participating in each test.
 - 4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.
- C. Commissioning schedule.
- D. Two-week look-ahead schedules.
- E. List test instrumentation, equipment, and monitoring devices. Include the following information:
 - 1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
 - 2. Brief description of intended use.
 - 3. Calibration record showing the following:
 - a. Calibration agency, including name and contact information.
 - b. Last date of calibration.
 - c. Range of values for which calibration is valid.
 - d. Certification of accuracy.
 - e. Certification for calibration equipment traceable to NIST.
 - f. Due date of the next calibration.

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F. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

G. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.4 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:
 - a. Pre-startup reports.
 - b. Approved test procedures
 - c. Test data forms completed and signed.
 - d. Progress reports.
 - e. Commissioning issue report log.
 - f. Commissioning issue reports showing resolution of issues.
 - g. Correspondence or other documents related to resolution of issues.
 - h. Other reports required by commissioning process.
 - i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
 - j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.

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- B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
 - 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
 - 2. Calibrated and certified.
 - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
 - 3. Maintain test equipment and instrumentation.
 - 4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
 - 1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
 - 2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

- A. General Format and Organization:
 - 1. Record report on compact disk.
 - 2. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.
- B. Commissioning Report:
 - 1. Include a table of contents and an index to each test.
 - 2. Include major tabs for each Specification Section.
 - 3. Include minor tabs for each test.
 - 4. Within each minor tab, include the following:
 - a. Test specification.
 - b. Pre-startup reports.
 - c. Approved test procedures.

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- d. Test data forms completed and signed.
- e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.
 - 1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
 - 2. Included optional features.
 - 3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
 - 4. Installation Checks:
 - a. Location according to Drawings and approved Shop Drawings.
 - b. Configuration.
 - c. Compliance with manufacturers' written installation instructions.
 - d. Attachment to structure.
 - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
 - f. Utility connections are of the correct characteristics, as applicable.
 - g. Correct labeling and identification.
 - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.

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- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.
- E. Performance Tests:
 - 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
 - 2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
 - 3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
 - 4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
 - 5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
 - 1. Identify deferred construction checklists by number and title.
 - 2. Provide a target schedule for completion of deferred construction checklists.
 - 3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.
- G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
 - 1. Identify delayed construction checklist by construction checklist number and title.
 - 2. Provide a target schedule for completion of delayed construction checklists.
 - 3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning process with the Construction Schedule.

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- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
 - 1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
 - a. General Inspection: Level I.
 - b. Special Inspection: Level S-1.
 - c. Acceptance Quality Limit (AQL) of 1.5.
 - 2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
 - 3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
 - 4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
 - 1. Operating the equipment and systems they install during tests.
 - 2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 CONTRACTOR'S RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:
 - 1. Coordinate with subcontractors on their commissioning responsibilities and activities.
 - 2. Obtain, assemble, and submit commissioning documentation.
 - 3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 01 3100 "Project Management and Coordination."
 - 4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
 - 5. Review and comment on preliminary test procedures and data forms.
 - 6. Report inconsistencies and issues in system operations.
 - 7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.

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8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 01 7900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.
- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.
- C. Construction Checklists:
 1. Complete construction checklists as Work is completed.
 2. Distribute construction checklists to installing contractors before they start work.
 3. Installers:
 - a. Verify installation using approved construction checklists as Work proceeds.
 - b. Complete and sign construction checklists daily for work performed during the preceding day.
 4. Provide Commissioning Authority access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

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- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

- F. Test Procedures and Test Data Forms:
 - 1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
 - 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
 - 3. Completed test data forms are the official records of the test results.
 - 4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
 - 5. Review preliminary test procedures and test data forms and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:
 - a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
 - b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
 - 6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
 - 7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

- G. Performance of Tests:
 - 1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
 - 2. Perform and complete each step of the approved test procedures in the order listed.
 - 3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
 - 4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
 - 5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be

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rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
 - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness and shall note the absence of Owner's witness at the scheduled time and place.
7. False load test requirements are specified in related sections.
 - a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:
 - a. Identify deferred tests by number and title.

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- b. Provide a target schedule for completion of deferred tests.
 2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
 3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.
- J. Delayed Tests:
 1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
 - a. Identify delayed tests by test number and title.
 - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
 2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
 3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.
- K. Commissioning Compliance Issues:
 1. Test results that are not within the range of acceptable results are commissioning compliance issues.
 2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
 3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
 4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
 - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
 - b. Submit commissioning compliance issue report form within 24 hours of the test.
 - c. Determine the cause of the failure.
 - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.

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5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
 - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
 - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
 - c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
 - d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
 - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
 - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
 - c. Record the results of each step of the diagnostic procedure.
 - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
 - e. Determine and record corrective measures.
 - f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
7. Retest:
 - a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
 - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
8. Do not correct commissioning compliance issues during test demonstrations.
 - a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data

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form marked "Retest," shall be initiated after the resolution has been completed.

3.6 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
 - 1. Construction Checklists:
 - a. Material checks.
 - b. Installation checks.
 - c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
 - d. Performance Tests:
 - 1) Static tests, as appropriate.
 - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
 - 3) Equipment and assembly performance tests.
 - 4) System performance tests.
 - 5) Intersystem performance tests.
 - 2. Commissioning tests.
- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.
- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.7 SCHEDULING

- A. Commence commissioning process as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 01 3200 "Construction Progress Documentation."
 - 1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
 - 2. Schedule the start date and duration for the following commissioning activities:
 - a. Submittals.

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- b. Preliminary operation and maintenance manual submittals.
 - c. Installation checks.
 - d. Startup, where required.
 - e. Performance tests.
 - f. Performance test demonstrations.
 - g. Commissioning tests.
 - h. Commissioning test demonstrations.
3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
 4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.
- C. Two-Week Look-Ahead Commissioning Schedule:
1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
 2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
 3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.
- D. Owner's Witness Coordination:
1. Coordinate Owner's witness participation via Architect.
 2. Notify Architect of commissioning schedule changes at least [two] <Insert number> work days in advance for activities requiring the participation of Owner's witness.

3.8 COMMISSIONING REPORTS

- A. Test Reports:
1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
 - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
 - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
 - c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing,

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- improperly configured, improperly installed, or nonfunctional components.
 - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
 - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
- a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
 - b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
 - c. Signatures of individuals performing and witnessing tests.
 - d. Data trend logs accumulated overnight from the previous day of testing.
3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
- a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
 - b. Action distribution list.
 - c. Report date.
 - d. Test number and description.
 - e. Equipment identification and location.
 - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
 - g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
 - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
 - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
 - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.

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- k. Schedule for retesting.
4. Weekly progress reports include information for tests conducted since the preceding report and the following:
 - a. Completed data forms.
 - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
 - c. Activities scheduled but not conducted per schedule.
 - d. Commissioning compliance issue report log.
 - e. Schedule changes for remaining Commissioning-Process Work, if any.
5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
 - a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
 - b. Attach to the data form printed trend log data collected during the test or test demonstration.
 - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."
 - a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.9 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

- A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to compete commissioning process.

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- B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.
- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Final Acceptance.

END OF SECTION 01 9113



ARCHITECTURAL SPECIFICATIONS

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SECTION 02 41 20 - SELECTIVE BUILDING DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 73 29 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, and for dust control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's adjacent operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of site immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing conditions provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction,

- to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 24-hours after flame-cutting operations. Coordinate duration with Owner's and Local Fire Marshall's requirements.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break

up and remove.

- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- E. Roofing: Coordinate roofing construction with existing exterior wall assembly and parapet wall as indicated on the Drawings. Ensure that existing roof membrane is protected such that building interior remains water and weathertight.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Floor and slab treatments.
 - 7. Bonding agents.
 - 8. Adhesives.
 - 9. Vapor retarders.
 - 10. Semirigid joint filler.
 - 11. Joint-filler strips.
 - 12. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PRODUCTS

1.9 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

1.10 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

1.11 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

1.12 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

1.13 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I/II,.
 - 2. Fly Ash: ASTM C 618, Class F.
 - 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
 - 4. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, portland blast-furnace slag cement.
 - 5. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
 - d. Sika Corporation.
- G. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Cortec Corporation.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
 - d. Sika Corporation.
- H. Water: ASTM C 94/C 94M and potable.
- 1.14 VAPOR RETARDERS
- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.
- 1.15 FLOOR AND SLAB TREATMENTS
- A. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
 - B. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1.16 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1.17 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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

- a. BASF Corporation; Construction Systems.
- b. Dayton Superior.
- c. Euclid Chemical Company (The); an RPM company.
- d. Sika Corporation.

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

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

- a. BASF Corporation; Construction Systems.
- b. Dayton Superior.
- c. Euclid Chemical Company (The); an RPM company.
- d. W. R. Meadows, Inc.

1.18 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

- B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

1.19 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

1.20 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Slag Cement: 50 percent.
 4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 5. Silica Fume: 10 percent.

6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

1.21 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Normal-weight concrete.
1. Minimum Compressive Strength: 3000 psi at 28 days or as indicated on drawings.
 2. Maximum W/C Ratio: 0.50.
 3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
- B. Slabs-on-Grade: Normal-weight concrete.
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum W/C Ratio: 0.45.
 3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
 4. Slump Limit: 4 inches, plus or minus 1 inch.
 5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
 6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

1.22 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

1.23 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

EXECUTION

1.24 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- D. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- E. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- F. Chamfer exterior corners and edges of permanently exposed concrete.

- G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

1.25 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

1.26 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

1.27 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

1.28 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

1.29 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer

and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

1.30 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

1.31 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated to receive trowel finish.
- C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- E. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.
- F. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

1.32 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

1.33 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

1.34 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than three days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

1.35 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

1.36 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

1.37 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.

- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified

- compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

1.38 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

PART 2 - END OF SECTION 03 30 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

- B. Products Installed but not Furnished under This Section:

1. Cavity wall insulation.

- C. Related Requirements:

1. Section 07 21 00 "Thermal Insulation" for cavity wall insulation.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).

- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Decorative CMUs.
2. Clay face brick, in the form of straps of five or more bricks.
3. Weep holes and cavity vents.
4. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.

7. Reinforcing bars.
 8. Joint reinforcement.
 9. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- 1.7 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- 1.9 FIELD CONDITIONS
- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- C. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar

additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ACM Chemistries.
 - 2) BASF Corporation; Construction Systems.
 - 3) Grace Construction Products; W.R. Grace & Co. -- Conn.

- D. Decorative CMUs: ASTM C 90.
 1. Density Classification: Normal weight.
 2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 3. Pattern and Texture:
 - a. Match existing.
 4. Colors: Match existing.
 5. Special Aggregate: Provide units made with aggregate matching existing

2.5 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Aggregate for mortar and grout, cement, and lime shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Masonry Cement: ASTM C 91/C 91M.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holcim (US) Inc.
 - b. Lafarge North America Inc.
 - c. Lehigh Hanson; HeidelbergCement Group.

- F. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C 404.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Grace Construction Products; W.R. Grace & Co. -- Conn.
- I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACM Chemistries.
 - b. BASF Corporation; Construction Systems.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. Grace Construction Products; W.R. Grace & Co. -- Conn.
- J. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dur-O-Wal; a Hohmann & Barnard company.
 - b. Heckmann Building Products, Inc.
 - c. Wire-Bond.

 - C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
 1. Interior Walls: Hot-dip galvanized carbon steel.
 2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Wire Size for Side Rods: 0.187-inch diameter.
 4. Wire Size for Cross Rods: 0.187-inch diameter.
 5. Wire Size for Veneer Ties: 0.187-inch diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

 - D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

 - E. Masonry-Joint Reinforcement for Multiwythe Masonry:
 1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

 - F. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized carbon-steel continuous wire.
- 2.7 TIES AND ANCHORS
- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

 - B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 4. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

- C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
 2. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 3. Wire: Fabricate from 3/16-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.
- E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot dip galvanized after fabrication.
- F. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 2. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 3. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
 4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Wire-Bond.
 5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and

with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and base for inserting wire tie.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Wire-Bond.
6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Heckmann Building Products, Inc.
 - 2) Hohmann & Barnard, Inc.
 - 3) Wire-Bond.
7. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B 117.
8. Stainless-Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless-steel shank.

2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual", Section 07 62 00 "Sheet Metal Flashing and Trim", and as follows:
 1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
 2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.

3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 4. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 7. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.
 9. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
 10. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
 11. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
 12. Solder metal items at corners.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - a. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1) [Du Pont.](#)
 - 2) [Hohmann & Barnard, Inc.](#)
 - 3) [Hyload, Inc.](#)

- 4) Mortar Net Solutions.
 - b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025-inch-thick, with a 0.015-inch-thick coating of adhesive.
 - c. Self-Adhesive Sheet with Stainless Steel Drip Edge: Elastomeric thermoplastic flashing, 0.025-inch-thick, with a 0.015-inch-thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
 - d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application: Unless otherwise indicated, use the following:
 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 2. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or elastomeric thermoplastic flashing with a drip edge.
 3. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- F. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches with a 3/8-inch sealant flange at top.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Advanced Building Products Inc.
 - 2) CavClear/Archovations, Inc.
 - 3) Mortar Net Solutions.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advanced Building Products Inc.
 - b. CavClear/Archovations, Inc.
 - c. Mortar Net Solutions.
2. Configuration: Provide the following:
 - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type N.
 - 4. For exterior, above-grade, load bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.
 - 5. For interior nonload-bearing partitions, Type O may be used instead of Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 - 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

- D. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:
 - 1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
 - a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
 - b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.
 - 2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
 - c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
 - 3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not more than 8 inches clear horizontally and 16 inches clear vertically.
 - 4. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

- D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.
- E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
 - 1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 - 1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.
 - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
 - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 - 3. Build in compressible joint fillers where indicated.
 - 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants."
- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch.
 - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
 - 3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
 - 4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
 - 5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
 - 7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Space weep holes 24 inches o.c. unless otherwise indicated.

- E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products or open-head joints to form cavity vents.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

3.14 PARGING

- A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
 - 7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 05 50 00 - MISCELLANEOUS METALS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 SECTION INCLUDES

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the miscellaneous metal work as indicated on the drawings and/or specified herein, including, but not limited to, the following:
 - 1. Rough hardware.
 - 2. Loose steel lintels.
 - 3. Light steel framing and supports, not included as part of work of other trades.
 - 4. Steel framing, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on drawings or as required to complete each item of work of this Section including as required for materials provided "by others" for installation.
 - 5. Prime painting, touch-up painting, galvanizing and separation of dissimilar metals for work of this Section.
 - 6. Cutting, fitting, drilling and tapping work of this Section to accommodate work of other Sections and of concrete, masonry or other materials as required for attaching and installing work of this Section.

1.3 QUALITY ASSURANCE

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
- B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

- C. Reference Standards: Refer to standards in Section 051200.
- D. Steel Materials: For steel to be hot dip-galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.
- E. Engage the services of a galvanizer who has demonstrated a minimum of five (5) years' experience in the successful performance of the processes outlined in this specification in the facility where the work is to be done and who will apply the galvanizing and coatings within the same facility as outlined herein. The Architect has the right to inspect and approve or reject the galvanizer/galvanizing facility.
- F. The galvanizer/galvanizing facility must have an ongoing Quality Control/Quality Assurance program which has been in effect for a minimum of five years and shall provide the Architect with process and final inspection documentation. The galvanizer/galvanizing facility must have an on-premise testing facility capable of measuring the chemical and metallurgical composition of the galvanizing bath and pickling tanks.
- G. Inspection and testing of hot-dip galvanized coating shall be done under the guidelines provided in the American Hot-Dip Galvanizers Association (AGA) publication "Inspection of Products Hot-Dip Galvanized After Fabrication."

1.4 SUBMITTALS

- A. Manufacturer's Literature: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in the fabrication of miscellaneous metal work, including paint products.
- B. Shop Drawings: Shop drawings for the fabrication and erection of all assemblies of miscellaneous iron work which are not completely shown by manufacturer's data sheets. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale. Show anchorage and accessory items.
- C. Engineering Data
 - 1. Before any ladders are fabricated, submit engineering data drawings to the Architect for review indicating how performance standards specified here shall be met. The Contractor is responsible for the structural design and supports for these systems and must show his proposed systems on these drawings.
 - 2. These drawings must show all load conditions and design calculations relative to

connections, fastening devices and anchorage, as well as size and gauge of members. Calculations and drawings must be prepared by a Structural Engineer licensed in the State of North Carolina and shall be signed and sealed by this Engineer.

- D. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes such as 1/4" weld, weld and tack weld are not acceptable.
- E. Certification: For items to be hot-dip galvanized, identify each item galvanized and to show compliance of application. The Certificate shall be signed by the galvanizer and shall contain a detailed description of the material processed and the ASTM standard used for the coating and, the weight of the coating. In addition, and as attachment to Certification, submit reports of testing and inspections indicating compliance with the provisions of this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Metals

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Steel Plates, Shapes and Bars: ASTM A 36.
3. Steel Tubing: Cold formed, ASTM A 500; or hot rolled, ASTM A 501.
4. Structural Steel Sheet: Hot rolled, ASTM A 570; or cold rolled, ASTM A 611, Class 1; of grade required for design loading.
5. Galvanized Structural Steel Sheet: ASTM A 924, of grade required for design loading. Coating designation G90.
6. Steel Pipe: ASTM A 53, type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.
7. Gray Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.
8. Malleable Iron Castings: ASTM A 47, grade as selected by fabricator.

9. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
 10. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A 153.
- B. Grout: Non-shrink, non-metallic grout conforming to the requirements of Section 03 30 00.
- C. Fasteners
1. General: Provide zinc-coated fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.
 2. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.
 3. Anchor Bolts: ASTM F 1554, Grade 36.
 4. Lag Bolts: ASME B18.2.1.
 5. Machine Screws: ASME B18.6.3.
 6. Plain Washers: Round, carbon steel, ASME B18.22.1.
 7. Masonry Anchorage Devices: Expansion shields, FS FF-S-325.
 8. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class and style as required.
 9. Lock Washers: Helical spring type carbon steel, ASME B18.21.1.
- D. Shop Paint: Shop prime all non-galvanized miscellaneous metal items using Series 88 Azeron Primer made by Tnemec, ICI Devoe "Rust Guard" quick dry alkyd shop coat No. 41403, or "Interlac 393" by International Protection Coatings.
1. If steel is to receive high performance coating as noted in Section 09 90 00, shop prime using primer noted in Section 09 90 00.
- E. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D 1187.
- F. Galvanizing Repair Coating: For touching up galvanized surfaces after erection, provide repair coating that is V.O.C. compliant, equal to "Silver Galv" made by Z.R.C. Worldwide or equivalent by Brite Products or Duncan Galvanizing. Apply to a dry film thickness of 1.5 to 3.0 mils.

2.2 PRIME PAINTING

- A. Scope: All ferrous metal (except galvanized steel) shall be cleaned and shop painted with one coat of specified ferrous metal primer. No shop prime paint required on galvanized steel or aluminum work.
- B. Cleaning: Conform to Steel Structures Painting Council Surface Preparation Specification SP 3 (latest edition) "Power Tool Cleaning" for cleaning of ferrous metals which are to receive shop prime coat.
 - 1. Steel to get high performance coating as noted in Section 09 90 00 shall be cleaned as per SSPC SP.6 "Commercial Blast Cleaning."
- C. Application
 - 1. Apply shop prime coat immediately after cleaning metal. Apply paint in dry weather or under cover. Metal surfaces shall be free from frost or moisture when painted. Paint all metal surfaces including edges, joints, holes, corners, etc.
 - 2. Paint surfaces which will be concealed after shop assembly prior to such assembly. Apply paint in accordance with approved paint manufacturer's printed instructions, and the use of any thinners, adulterants or admixtures shall be only as stated in said instructions.
 - 3. Paint shall uniformly and completely cover the metal surfaces, 2.0 mils minimum dry film thickness. No work shall be shipped until the shop prime coat thereon has dried.
- D. Touch-Up: In the shop, after assembly and in the field, after installation of work of this Section, touch-up damaged or abraded portions of shop prime paint with specified ferrous metal primer.
- E. Apply one shop coat to fabricated metal items, except apply two (2) coats of paint to surfaces inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

2.3 GALVANIZING

- A. Scope: All ferrous metal exposed to the weather, and all ferrous metals indicated on drawings or in specifications to be galvanized, shall be cleaned and then hot-dipped galvanized after fabrication as provided by Duncan Galvanizing, Valmont, Inc., Elderlee, Inc. or approved equal.
- B. Avoid fabrication techniques that could cause distortion or embrittlement of steel items to be hot-dip galvanized. Fabricator shall consult with hot-dip galvanizer regarding potential

warpage problems or handling problems during the galvanizing process that may require adjustment of fabrication techniques or design before finalizing shop drawings and beginning of fabrication.

- C. Cleaning: Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.
- D. Application: Hot-dip galvanizing shall conform to the following:
 - 1. ASTM A 143: Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.
 - 2. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A 153: Galvanized Coating on Iron and Steel Hardware - Table 1.
 - 4. ASTM A 384: Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 - 5. ASTM A 385: Practice for Providing High Quality Zinc Coatings.
 - 6. ASTM A 924: Galvanized Coating on Steel Sheets.
 - 7. Minimum weight of galvanized coating shall be two (2) oz. per square foot of surface.
- E. Fabricate joints which will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.
- F. All galvanized materials must be inspected for compliance with these specifications and marked with a stamp indicating the name of the galvanizer, the weight of the coating, and the appropriate ASTM number.
- G. To minimize surface imperfection (eg: flux inclusions), material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.
- H. After galvanizing all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.
- I. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Where this does not occur, piece shall be rejected and replaced to the acceptance of the Architect.

2.4 PROTECTIVE COATINGS

- A. Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one coat of specified bituminous paint, which shall be in addition to the specified shop prime paint. Mask off those surfaces not required to receive protective coating.

2.5 WORKMANSHIP

A. General

1. Miscellaneous metal work shall be fabricated by an experienced fabricator or manufacturer and installed by an experienced tradesman.
2. Materials, methods of fabrication, fitting, assembly, bracing, supporting, fastening, operating devices, and erection shall be in accordance with drawings and specifications, approved shop drawings, and best practices of the industry, using new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected.
3. All work shall be accurately and neatly fabricated, assembled and erected.

- B. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Shop assemble work in largest practical sizes to minimize field work. It is the responsibility of the miscellaneous metal subcontractor to assure himself that the shop-fabricated miscellaneous metal items will properly fit the field condition. In the event that shop-fabricated miscellaneous metal items do not fit the field condition, the item shall be returned to the shop for correction.

- C. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

- D. Holes: Drill or cleanly punch holes; do not burn.

- E. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Architect.

1. Welding

- a. Shall be in accordance with AWS D1.1 Structural Welding Code of the American

Welding Society, and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.

- b. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
 - c. All welds on or behind surfaces which will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.
2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.
- F. Operating Mechanism: Operating devices (i.e. pivots, hinges, etc.) mechanism and hardware used in connection with this work shall be fabricated, assembled, installed and adjusted after installation so that they will operate smoothly, freely, noiselessly and without excessive friction.
- G. Built-In Work: Furnish anchor bolts, inserts, plates and any other anchorage devices, and all other items specified under this Section of the Specifications to be built into concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.
- H. Supplementary Parts: Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.
- I. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.
- J. Exposed Work
1. In addition to requirements specified herein and shown on drawings, all surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, burrs, and other defects which mar appearance of finished work.
 2. Metal work exposed to view shall be straight and true to line or curve, smooth arrises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.

3. Exposed fastenings, where permitted, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.
 4. Prime and paint plates, pipes, vents, downspouts, escutcheons, sleeves, etc. exposed at bldg elevations as follows:
 - α. Finish K: To match Architect's sample or adjacent surface unless otherwise noted.
- K. Preparation for Hot-Dip Galvanizing: Fabricator shall correctly prepare assemblies for galvanizing in consultation with galvanizer and in accordance with applicable Reference Standards and applicable AGA publications for the "Design of Products to be Hot-Dip galvanized After Fabrication." Preparation shall include but not be limited to the following:
1. Remove welding flux.
 2. Drill appropriate vent holes and provide for drainage in inconspicuous locations of hollow sections and semi-enclosed elements. After galvanizing, plug vent holes with shaped lead and grind smooth.

2.6 MISCELLANEOUS METALS ITEMS

- A. Rough Hardware
1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.
 2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood connections; elsewhere, furnish steel washers.
- B. Loose Steel Lintels: Provide loose structural steel lintels for openings and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than eight (8) inches bearing at each side of openings, unless otherwise indicated.

1. Loose lintels shall conform to the following Schedule:

Opening Width (Maximum)	WALL THICKNESS		
	4 inches	6 inches	8 inches*
2'-0"	3-1/2" x 3-1/2" x	6" x 4" x 5/16"	3-1/2" x 3-1/2" x 1/4"
3'-0"	3-1/2" x 3-1/2" x	6" x 4" x 5/16"	3-1/2" x 3-1/2" x
4'-0"	3-1/2" x 3-1/2" x	6" x 4" x 5/16"	3-1/2" x 3-1/2" x
5'-0"	4" x 3-1/2" x 3/8"	6" x 4" x 3/8"	4" x 3-1/2" x 5/16"
6'-0"	5" x 3-1/2" x 3/8"	6" x 4" x 3/8"	5" x 3-1/2" x 5/16"
7'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 1/2"	5" x 3-1/2" x 3/8"
8'-0"	5" x 3-1/2" x 3/8"	5" x 5" x 5/8"	5" x 3-1/2" x 3/8"

* Two angles at all openings in eight (8) inch walls.

2. At columns or vertical surfaces where lintels cannot bear on masonry, provide clip angles sized for structural capacity of lintel.

C. Miscellaneous Light Steel Framing

1. Light steel framing, bracing, supports, framing, clip angles, shelf angles, plates, etc., shall be of such shapes and sizes as indicated on the drawings and details or as required to suit the condition and shall be provided with all necessary supports and reinforcing such as hangers, braces, struts, clip angles, anchors, bolts, nuts, welds, etc., as required to properly support and rigidly fasten and anchor same in place and to steel, concrete, masonry and all other connecting and adjoining work.
2. All light steel framing steel shall be furnished and erected in accordance with the applicable requirements of the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" by the American Institute of Steel Construction and as specified herein.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions where miscellaneous metal is to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

3.2 ERECTION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation,

plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

- C. Fitting Connections: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.
- E. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- F. Field Touch-Up of Galvanized Surfaces: Touch-up shop applied galvanized coatings damaged during handling and installation. Use galvanizing repair coating specified herein for galvanized surfaces.

END OF SECTION 05 50 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Polyisocyanurate foam-plastic board.
3. Glass-fiber blanket.

- B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
2. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Kingspan Insulation.
 - c. Owens Corning.
 2. Average LTTR R-Value: 5.0 per inch.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board Roof Insulation, Nailable (TOP LAYER): Provide 2-1/2" thick rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core bonded to 19/32" thick CDX Plywood on the top side and a fiber-reinforced felt facer on the bottom side; equal to "ACFoam Nail Base" as manufactured by Atlas Roofing Company, or equal by Rmax, GAF, **Kurt Building Materials**, or approved equal, complying with ASTM C 1289, Type V, Grade 2 (20psi), average LTTR value as designated at mean temperatures indicated after testing per ASTM C 1303 as follows:
1. Average LTTR R-Value: 5.6/inch at 75 deg. F.
 2. Surface Burning Characteristics: Maximum flame spread of 25.

- B. Polyisocyanurate Board Roof Insulation (BASE LAYER): Provide 2-1/2" thick rigid, cellular thermal insulation with polyisocyanurate closed-cell foam core bonded to a fiber-reinforced felt facer on the top and bottom side; equal to "ACFoam-II" as manufactured by Atlas Roofing Company, or equal by Rmax, GAF or approved equal, complying with ASTM C 1289, Type II, Class 1, Grade 2 (20psi), average LTTR value as designated at mean temperatures indicated after testing per ASTM C 1303 as follows:

1. Average LTTR R-Value: 5.6/inch at 75 deg. F.
2. Surface Burning Characteristics: Maximum flame spread of 25.

2.3 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
2. Average R-Value of not less than 3.7 per inch and shall be 3" thick unless otherwise noted on the drawings.

- B. Glass-Fiber Blanket, Reinforced-Foil Faced: Provide flexible glass fiber blankets/batts conforming to ASTM C 612, Type 1A or ASTM C 665, Type III, Class A, faced on one side with foil reinforced Kraft vapor retarder; maximum flame spread and smoke developed indices 25 and 50 respectively.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
2. Insulation shall have an R value of not less than 3.7/inch and shall be 3.5" thick unless otherwise noted on the drawings.

2.4 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed toward exterior of construction.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof curbs.
 - 2. Equipment supports.
 - 3. Pipe and duct support.
 - 4. Pipe portals.
 - 5. Preformed flashing sleeves.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

- C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.
- D. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of North Carolina, responsible for their preparation.
 - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
 - 2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure.
 - 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 - 4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Final Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of North Carolina, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.

2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [AES Industries, Inc.](#)
 - b. [Curbs Plus, Inc.](#)
 - c. [Custom Solution Roof and Metal Products.](#)
 - d. [Greenheck Fan Corporation.](#)
 - e. [Milcor; Commercial Products Group of Hart & Cooley, Inc.](#)
 - f. [Roof Products, Inc.](#)
 - g. [Thybar Corporation.](#)

- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Stainless-steel sheet, 0.078 inch (1.98 mm) thick.
 - 1. Finish: Manufacturer's standard.
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
 - 3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
 - 4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
 - 5. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
 - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
 - 7. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
 - 8. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Internally reinforced perimeter and Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AES Industries, Inc.
 - b. Curbs Plus, Inc.
 - c. Custom Solution Roof and Metal Products.
 - d. Greenheck Fan Corporation.
 - e. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - f. Roof Products, Inc.
 - g. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

- C. Material: Stainless-steel sheet, 0.078 inch (1.98 mm) thick.
 - 1. Finish: Manufacturer's standard.
- D. Construction:
 - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 - 2. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
 - 3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
 - 4. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
 - 5. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
 - 6. Fabricate equipment supports to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
 - 7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 PIPE AND DUCT SUPPORTS

- A. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; accommodating up to 7-inch- (178-mm-) diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, mod-bit base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless-steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.
- B. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch- (508-mm-) diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries, Inc.
 - b. Pate Company (The).
 - c. PHP Systems/Design.
 - d. Thaler Metal Industries Ltd.

- C. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches (50 mm) in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.
 - 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. Thaler Metal Industries Ltd.
 - 2. Finish: Manufacturer's standard.

2.5 PIPE PORTALS

- A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped mod-bit protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.
 - 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. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.

2.6 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and slotted metal collar.
 - 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. Custom Solution Roof and Metal Products.
 - b. Menzies Metal Products.
 - c. Thaler Metal Industries Ltd.
 - 2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
 - 3. Diameter: As indicated on Drawings.
 - 4. Finish: Manufacturer's standard.

- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
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. Custom Solution Roof and Metal Products.
 - b. Menzies Metal Products.
 - c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - d. Thaler Metal Industries Ltd.
 2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
 3. Height: 13 inches (330 mm).
 4. Diameter: As indicated on Drawings.
 5. Finish: Manufacturer's standard.

2.7 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 1. Mill Finish: As manufactured.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.8 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, thickness as indicated.
- C. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), thickness as indicated.
- D. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
- E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

- F. Underlayment:
 - 1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS- modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 2. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

- C. Roof Curb Installation: Install each roof curb so top surface is level.

- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

- E. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
 - 1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

- F. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

- G. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

- a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
 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. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. NUCO Inc.
 - d. Tremco, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg (2.49 Pa)**.
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of **0.01-inch wg (2.49 Pa)**.
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of **0.30-inch wg (74.7 Pa)**.
 1. L-Rating: Not exceeding **5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m)** of penetration opening at and no more than **50-cfm (0.024-cu. m/s)** cumulative total for any **100 sq. ft. (9.3 sq. m)** at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by

penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- K. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate

proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

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

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than **3 inches (76 mm)** high and with minimum **0.375-inch (9.5-mm)** strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at **15 feet (4.57 m)** from end of wall and at intervals not exceeding **30 feet (9.14 m)**.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Final Acceptance. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 07 84 13

SECTION 07 84 43 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior wall/floor intersections.
 - 3. Joints in smoke barriers.
- B. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
 - 2. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."

2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
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. [3M Fire Protection Products.](#)
 - b. [Hilti, Inc.](#)
 - c. [NUCO Inc.](#)
 - d. [ROXUL.](#)
 - e. [Thermafiber, Inc.; an Owens Corning company.](#)
 - f. [Tremco, Inc.](#)
 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
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. [3M Fire Protection Products.](#)
 - b. [Hilti, Inc.](#)
 - c. [NUCO Inc.](#)
 - d. [ROXUL.](#)
 - e. [Thermafiber, Inc.; an Owens Corning company.](#)
 - f. [Tremco, Inc.](#)
 - g.
 2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of **0.30-inch wg (74.7 Pa)**.
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. [3M Fire Protection Products.](#)
 - b. [Hilti, Inc.](#)
 - c. [NUCO Inc.](#)

- d. [ROXUL](#).
 - e. [Thermafiber, Inc.; an Owens Corning company](#).
 - f. [Tremco, Inc.](#)
2. L-Rating: Not exceeding **5.0 cfm/ft. (0.00775 cu. m/s x m)** of joint at both ambient and elevated temperatures.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Final Acceptance. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes joint sealants for the following applications:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - c. Control and expansion joints in ceilings and other overhead surfaces.
 - d. Insert other exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - e. All joints between dissimilar materials where one or both materials were installed as part of this project.
2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of walls and partitions.
 - d. Perimeter joints between interior wall surfaces and frames of interior doors.
 - e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - f. All joints between dissimilar materials where one or both materials were installed as part of this project.

- B. Related Sections include the following:

1. Division 08 Section "Glazing" for glazing sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.

2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Field-Adhesion-Test Reports: For each sealant application tested.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Final Acceptance.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Final Acceptance.

- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
 - 1. Architectural sealants shall have a VOC content of 250 g/L or less.
 - 2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
 - 3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Generally retain paragraph below with silicones applied to porous substrates such as marble, limestone, granite, and sandstone.
- C. Single-Component Nonsag Urethane Sealant (All Exterior Locations):
 - 1. Products:
 - a. Bostik Findley; Chem-Calk 900.
 - b. Bostik Findley; Chem-Calk 915.
 - c. Bostik Findley; Chem-Calk 916 Textured.
 - d. Bostik Findley; Chem-Calk 2639.
 - e. Pecora Corporation; Dynatrol I-XL.
 - f. Polymeric Systems Inc.; Flexiprene 1000.
 - g. Polymeric Systems Inc.; PSI-901.
 - h. Schnee-Morehead, Inc.; Permathane SM7100.
 - i. Schnee-Morehead, Inc.; Permathane SM7108.
 - j. Schnee-Morehead, Inc.; Permathane SM7110.
 - k. Tremco; DyMonic.
 - l. Tremco; Vulkem 921.
 - m. Tremco; Vulkem 931.
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: Color anodic aluminum, aluminum coated with a high-performance coating galvanized steel brick, ceramic tile, wood.

2.4 LATEX JOINT SEALANTS (All Interior Locations, u.o.n.)

- A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:

1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Schnee-Morehead, Inc.; SM 8200.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.7 PICK PROOF SECURITY JOINT SEALANTS

- A. 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:
1. Sika Corporation US. - "Sikadur 23 Lo-Mod Gel
 2. Pecora Corporation "Dynaflex-SC"
 3. Surebond, Inc. - Pick Proof Adhesive Sealant "SB-190"
 4. Sonneborn (BASF) "Ultra"
- B. Joint-Sealant Backing: Cylindrical.
- C. General: All indicated joints and other sealant locations, including precast concrete, masonry, and hollow metal perimeter joints that are within the detention or prisoner holding areas (I-3). Use Group areas, indicated on the Life Safety Drawings and exposed to view shall comply with requirements for security sealants. Joints above ceilings, covered by expansion joint covers, or otherwise concealed are excluded. Provide elastomeric security sealants ("tamper-resistant") for supervised inmate occupied areas within the perimeter security fence; and low-mod gel security sealants ("pick resistant") for cells and other inmate-occupied areas not subject to continuous supervision, located within the secure perimeter. Low-mod gel ("pick resistant") sealants are not for use in building joints that require movement such as control and expansion joints; provide "tamper resistant" sealant at these locations. (See below.)
1. Security sealants are referenced in Division 11 Section.
 2. Provide joint backer material for elastomeric security sealant.
 3. Do not use joint backer material for low-mod gel security sealant; install as a "grout" in accordance with manufacturer's recommendations.
 4. In cells, provide security sealant ("pick-resistant") at all **perimeter joints** of all permanent materials and objects (i.e. plaster security ceilings, floors, concrete bunkbed, security hollow metal frames, air grilles, wall embed plates).
 5. In cells provide security sealant ("tamper-resistant") at all **perimeter joints** of removable objects (i.e. surface mounted toilet fixtures, inmate emergency inter-com, security speaker and any exposed wiring devices such as cover plates of wall switches, receptacles specified in Divisions 22, 23, 26 and 27).
 6. Provide security sealant ("tamper resistant") for all exposed voids between finish materials, and between finish materials and surface mounted devices that inmates could use to hide contraband in inmate-accessible rooms inside the secure perimeter. Provide also at VCT termination at CMU walls where no base is scheduled (only painted base), and at joint between ceiling and wall.

- D. Elastomeric Security Sealant (“Tamper-Resistant”): Provide one or two-part non sag polyurethane or epoxy based elastomeric sealant for Use NT to comply with either ASTM C 920, Type S or M; Grade NS; minimum Class 12.5; and Uses NT, M, G, A, & concrete with durometer hardness of 50 or greater; or ASTM C881-90 Type I, II, IV, & V, grade 3, epoxy adhesive resin; made for abuse resistant applications.
1. Products: Provide one of the following:
 - a. “MasterSeal CR 195”; BASF.
 - b. “Dynaflex”; Pecora Corp.
 - c. “Sikaflex 51 NS”; Sika Corp.
 - d. “Prison-Loc 30”; Polytite Construction Products
 - e. “Vulkem 617”; Mameco
 2. Applications: Provide elastomeric security sealants (“tamper-resistant”) for supervised inmate occupied areas within the secure perimeter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean, porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

- a. Concrete.
 - b. Masonry.
3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Final Acceptance. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed steel studs and tracks and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A 653/A 653M, **G60 (Z180)**, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645. Use steel studs and tracks.
1. Steel Studs and Tracks:
 - a. **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:
 - 1) [MarinoWARE.](#)
 - 2) [MBA Building Supplies.](#)
 - 3) [Phillips Manufacturing Co.](#)
 - 4) [Steel Network, Inc. \(The\).](#)
 - b. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection.
 - c. Depth: As indicated on Drawings.
- C. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [ClarkDietrich Building Systems.](#)
 - b. [MarinoWARE.](#)
 - c. [Metal-Lite.](#)
 - d. [Steel Network, Inc. \(The\).](#)
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [ClarkDietrich Building Systems.](#)
 - b. [MarinoWARE.](#)

- c. [MRI Steel Framing, LLC.](#)
 - d. [SCAFCO Steel Stud Company.](#)
2. Minimum Base-Metal Thickness: As indicated on Drawings.
- E. Cold-Rolled Channel Bridging: Steel, **0.0538-inch (1.367-mm)** minimum base-metal thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
 1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. [ClarkDietrich Building Systems.](#)
 - b. [MarinoWARE.](#)
 - c. [MRI Steel Framing, LLC.](#)
 - d. [SCAFCO Steel Stud Company.](#)
 2. Depth: As indicated on Drawings.
 3. Clip Angle: Not less than **1-1/2 by 1-1/2 inches (38 by 38 mm)**, **0.068-inch- (1.72-mm-)** thick, galvanized steel.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, **0.16 inch (4.12 mm)** in diameter.
- C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of **0.0538 inch (1.367 mm)** and minimum **1/2-inch- (13-mm-)** wide flanges.
 1. Depth: **2-1/2 inches (64 mm).**

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: 48 inches (1219 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.

3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.

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

- a. American Gypsum.
- b. CertainTeed Corporation.
- c. Georgia-Pacific Building Products.
- d. National Gypsum Company.
- e. United States Gypsum Company.

- 2. Thickness: **5/8 inch (12.7 mm).**

- 3. Long Edges: Tapered.

- B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

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

- a. American Gypsum.
- b. CertainTeed Corporation.
- c. Georgia-Pacific Building Products.
- d. National Gypsum Company.
- e. United States Gypsum Company.

- 2. Thickness: **5/8 inch (12.7 mm).**

- 3. Long Edges: Tapered.

- C. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Building Products.
 - d. National Gypsum Company.
 - e. United States Gypsum Company.
 - 2. Core: **1/2 inch (12.7 mm)**, regular type.
 - 3. Long Edges: Tapered.
 - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
 - 2. Ceiling Type: Ceiling surfaces.
 - 3. Mold-Resistant Type: As indicated on Drawings or wet areas.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. Bullnose Bead: Use where indicated.
 3. LC-Bead: Use at exposed panel edges.
 4. L-Bead: Use where indicated.
 5. U-Bead: Use where indicated.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PRODUCTS

1.9 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class C materials.
 - 2. Smoke-Developed Index: 450 or less.

1.10 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

1.11 ACOUSTICAL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. United States Gypsum Company.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: D (fissured).
- C. Color: White.
- D. LR: Not less than 0.80.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

1.12 METAL SUSPENSION SYSTEMS, GENERAL

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

1.13 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corporation.
 - 3. United States Gypsum Company.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel or aluminum cold-rolled sheet.
 - 5. Cap Finish: Painted white.

EXECUTION

1.14 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

1.15 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

1.16 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 6. Do not attach hangers to steel deck tabs.

7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

1.17 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

PART 2 - END OF SECTION 09 51 13

SECTION 09 91 23 PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years' experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.
- D. Extra Materials: Supply 1 gallon of each color; store where directed. Label each container with color in addition to manufacturer's label.

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Basis of Design Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com .
 - 2. Duron, Inc: www.duron.com .
 - 3. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com .

4. Benjamin Moore & Co: www.benjaminmoore.com .
5. PPG Paints: www.ppgpaints.com.

C. Transparent Finishes:

1. Base Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com .
2. Behr Process Corporation: www.behr.com .
3. Glidden Professional, a product of PPG Architectural Coatings:
www.gliddenprofessional.com.

D. Block Fillers: Same manufacturer as top coats.

E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.

1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Supply each coating material in quantity required to complete entire project's work from a single production run.
3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

- b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - 4) Varnishes: 350 g/L, maximum.
 - 5) Block filler: 50 g/L, maximum.
 - 6) Interior Latex Primer: 50 g/L, maximum.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- 2.03 PAINT SYSTEMS – EXTERIOR – Not used
- 2.04 PAINT SYSTEMS - INTERIOR

A. Concrete/Masonry, Opaque, Latex, 2 Coat:

1. One coat Acrylic Block Filler.
 - a. Sherwin-Williams: Heavy Duty Block Filler, B42W46
 - b. PPG: Pitt-Glaze Acrylic Block Filler, 16-90
 - c. Benjamin Moore: CoroTech Acrylic Block Filler, V114
2. Semi-gloss: Two coats of latex enamel
 - a. Sherwin-Williams: Pre-Catalyzed Epoxy Semi-Gloss, K46-150 Series
 - b. PPG: Pitt-Glaze WB1 Pre-Catalyzed Epoxy S-G, 16-510
 - c. Benjamin Moore: Pre-Catalyzed Epoxy Semi-Gloss, V341
3. Color: To be selected

- B. Ferrous Metals, Primed, Latex, 2 Coat (All interior HM doors & frames).
 - 1. Touch-up with latex primer.
 - 2. Semi-gloss: Two coats of latex enamel.
 - a. Sherwin-Williams DTM Acrylic Semi-Gloss, B66-500 Series
 - b. PPG: Pitt-Tech Plus DTM Acrylic Semi-Gloss, 90-1210
 - c. Benjamin Moore: SuperSpec HP DTM Acrylic SG, P29
 - 3. Color: To be selected.

- C. Gypsum Board, Latex-Acrylic, 3 Coat (interior gypsum wallboard):
 - 1. One coat of alkyd primer sealer.
 - a. Sherwin-Williams: ProMar 200 Primer, B28W2600
 - b. PPG: Pure Performance Primer, 9-900
 - c. Benjamin Moore: Natura Latex Primer, 511
 - 2. Semi-gloss: Two coats of latex-acrylic enamel;
 - a. Sherwin-Williams: Pre-Catalyzed Epoxy Semi-Gloss, K46-150 Series
 - b. PPG: Pitt-Glaze WB1 Pre-Catalyzed Epoxy S-G, 16-510
 - c. Benjamin Moore: Pre-Catalyzed Epoxy Semi-Gloss, V341
 - 3. Eggshell: Two coats of latex-acrylic enamel;
 - a. Sherwin-Williams Harmony low VOC
 - b. PPG, low VOC
 - c. Benjamin Moore, low VOC
 - 4. Color: To be selected.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING:

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Final Acceptance.

END OF SECTION 09 91 23

SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wire mesh equipment barriers.

1.2 DEFINITIONS

- A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.
- B. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wire mesh equipment barriers.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Indicate clearances required for operation of gates.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for units with factory-applied color finishes.
- D. Samples for Verification: Panel constructed of specified frame members and wire mesh. Show method of finishing members at intersections.
 - 1. Size: 12 by 12 inches (300 by 300 mm).
- E. Delegated Design Submittals: For wire mesh partitions indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Certificates:
 - 1. Welding certificates.
- B. Qualification Statements: For Installer.
- C. Delegated design engineer qualifications.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wire mesh partition hardware.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Locks: Furnish 5 percent of quantity installed for each type indicated, but no fewer than 2 locks.

1.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer, Authorized representative who is trained and approved by manufacturer.
 - 2. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
 - a. AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire mesh items palleted to provide protection during transit and Project-site storage. Use vented plastic.
- B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.

1. Tag each item or package separately with identification and include basic installation instructions with each item or package.
- C. Deliver keys to Owner by registered mail or overnight package service, addressed as follows:
 1. North Carolina Correctional Institution For Women: 1034 Bragg Street, Raleigh, NC 27610

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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:
 1. Acorn Wire & Iron Works.
 2. American Wire Corporation.
 3. Kenco Wire & Iron Products Inc.
 4. Standard Wire & Steel Works.
 5. WIPCO; a division of Jesco Industries, Inc.

2.2 SOURCE LIMITATIONS

- A. For wire mesh products, obtain each color, grade, finish, type, and variety from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wire mesh units.
- B. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m) at any location on a panel.
2. Total load of 200 lbf (0.89 kN) applied uniformly over each panel.
3. Concentrated load and total load need not be assumed to act concurrently.
4. .

C. Seismic Performance: Wire mesh units to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.4 WIRE MESH EQUIPMENT BARRIERS

- A. Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond mesh.
- B. Panels: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel angle framing on four sides, with wire mesh welded to framing.
 1. Horizontal Panel Stiffeners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel angles or 3/4-by-1/4-inch (19-by-6.4-mm) hot-rolled steel flat bars.
 2. Height: same height with existing fence of the building.
- C. Line and Corner Posts: 2-by-2-by-0.068-inch (50-by-50-by-1.7-mm) steel tubing with steel base plates welded to bottoms, drilled for attachment to floor, and with steel caps welded to tops.
 1. Height: same height with existing fence of the building or as indicated on the drawings.
- D. Swinging Gates: Fabricated from same mesh as panels, with gate framing fabricated from 1-1/4-by-1-1/4-by-3/16-inch (32-by-32-by-4.7-mm) steel angles on four sides, and with wire mesh welded to framing.
 1. Hinges: Full-surface spring type, 3-1/2-by-3-1/2-inch (89-by-89-mm) steel, one pair per door; bolted, riveted, or welded to door and jamb framing.
 2. Padlock Lug: Mortised into door framing and enclosed with steel cover.
 3. Cylinder Lock: Mortise type with manufacturer's standard cylinder; operated by key outside and lever inside.
- E. Finish for Uncoated Ferrous Steel: Hot-dip galvanized unless otherwise indicated.

2.5 MATERIALS

- A. Steel Wire: ASTM A510/A510M.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.

- C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- D. Steel Pipe: ASTM A53/A53M, Schedule 40, unless another weight is indicated or required by structural loads.
- E. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.
- F. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with **G60 (Z180)** zinc (galvanized) or **A60 (ZF180)** zinc-iron-alloy (galvannealed) coating designation.
- G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- H. Post-Installed Anchors: Capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group **1 (A1)** stainless steel bolts, **ASTM F593 (ISO 3506)**, and nuts, **ASTM F594 (ASTM F836M)**.
- I. Power-Driven Fasteners: ICC-ES AC70.
- J. Seismic Bracing: Angles with legs not less than **1-1/4 inches (32 mm)** wide, formed from **0.040-inch- (1.0-mm-)** thick, metallic-coated steel sheet; with bolted connections and **1/4-inch- (6-mm-)** diameter bolts.
- K. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting"
- L. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer, complying with MPI#79.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- M. Zinc-Rich Primer: Compatible with topcoat, complying with SSPC-Paint 20 or SSPC-Paint 29.
- N. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.6 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
 - 1. Fabricate wire mesh items to be readily disassembled.
 - 2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

2.7 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Shop Priming: Apply shop primer to uncoated surfaces of wire mesh units unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
- E. Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard enamel finish, suitable for use indicated, with a minimum dry film thickness of **2 mils (0.05 mm)**.
 - 1. Color and Gloss: match Color and Finish of existing fence of the building.
- F. Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on powder-coat finish, suitable for use indicated, with a minimum dry film thickness of **2 mils (0.05 mm)**.
 - 1. Color and Gloss: match Color and Finish of existing fence of the building.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRE MESH EQUIPMENT BARRIERS

- A. Anchor wire mesh equipment barriers to floor with **3/8-inch- (9.5-mm-)** diameter, expansion anchors through post bases. Shim post bases as required to achieve level and plumb installation.
- B. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if indicated on Shop Drawings.
- C. Install gates complete with gate hardware.

3.3 REPAIR

- A. Repair Painting:
 - 1. Wire brush and clean rust spots, welds, and abraded areas immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.
 - 2. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.4 ADJUSTING

- A. Adjust gates to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

3.5 PROTECTION

- A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION 10 22 13

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

PART 1 GENERAL

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

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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 specification 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

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repairs or replacements caused by these defects within the period covered by the guarantee, including all incidental work required to correct the deficiency. Warranty repair shall be provided at no cost to the owner.

- 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 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 label, 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:

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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.

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- 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 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.

1.7 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.

1.8 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:

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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 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.

3.4 WELDING

- 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.

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- B. All welded piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 200 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.

3.5 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 to the owner's construction manager.
- E. Prime Bidders shall request a substitution on the letterhead stationary of the Prime Bidder submitting the request. Requests from individual manufacturers will not be accepted.
- F. Submit separate request for each substitution.

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- 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.

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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.

3.6 SUBMITTALS

- A. Refer to Division 1 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. PRODUCT SUBMITTALS

The following product data information shall be submitted:

PRODUCT	SUBMITTED	APPROVED
Air-Cooled Chiller	_____	_____
Air Filters	_____	_____
Air Handling Units	_____	_____
Air Distribution Devices	_____	_____
Air Separators	_____	_____
Air Vents	_____	_____
Balancing Fittings	_____	_____
Dampers	_____	_____
Dielectric Fittings	_____	_____
Duct Sealants	_____	_____
Electric Heat Tape	_____	_____
Fans	_____	_____
Flexible Pipe Connections	_____	_____
Flow Control Fittings/Valves	_____	_____
Flow Meters	_____	_____
Hot & Chilled Water Specialties	_____	_____
Insulation, Mastics and Sealants	_____	_____
Packaged Air Handling Units	_____	_____
Pressure Gauges	_____	_____
Pumps (with performance curves)	_____	_____
Sheet Metal Specialties	_____	_____
Temperature Controls/BAS	_____	_____
Test Wells, Thermometers	_____	_____
Unit Ventilators	_____	_____

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Valves and Strainers	_____	_____
Variable Frequency Drives	_____	_____
Vibration Isolators	_____	_____
Water Treatment	_____	_____

E. 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 leak test
 - b) Duct pressure test
 - c) System start-up
 - d) Test and Balance Agency Construction report.
 - e) Water chemistry
 - f) All required Test Reports
 - g) Required Pressurization Systems

F. CONTROL SUBMITTAL:

Submit drawings on control systems including the following.

1. All control components
2. All information necessary for a clear representative of the system to be provided.
3. Graphical representative of all systems to be controlled.
4. I/O summary sheets.
5. Floor plan indicating panels.
6. Sequence of operation. All devices referenced in the sequence shall be indicated on graphic representation.
7. Large scale (75% reduction maximum) of a control panel faces.
8. Wiring diagrams including interface with equipment (terminal strip, contactor, etc.)

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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.

3.7 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 shall be delivered to the Designer. All drawing costs to be paid by the Contractor.
- C. Prints 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.

3.8 OPERATION AND MAINTENANCE MANUALS:

- A. 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.

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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.
- B. The following diagrams, schematics and lists shall be framed under Plexiglas 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

3.9 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.
- B. Instruction period shall be performed during the forty-five (45) days following substantial completion at time periods as approved by Owner.

3.10 CONTROLS OPERATION AND MAINTENANCE INSTRUCTION:

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- 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, chiller 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.

3.11 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

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SECTION 23 01 30 – HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.1 SYSTEMS AND COMPONENTS TO BE CLEANED:

- A. Existing items that will remain subsequent to demolition as noted below.
- B. Return-air ducts, dampers, actuators and turning vanes.
- C. Supply-air ducts, dampers, actuators and turning vanes.

1.2 REFERENCES

- A. National Air Duct Cleaners Association (NADCA): “Assessment, Cleaning & Restoration of HVAC Systems (ACR).”
- B. National Air Duct Cleaners Association (NADCA): “Introduction to HVAC System Cleaning Services,” 2004.
- C. Underwriters’ Laboratories (UL): UL Standard 181.

1.3 QUALIFICATIONS

- A. The HVAC system cleaning contractor performing the assessment shall be an Air Systems Cleaning Specialist (ASCS), Certified Ventilation Inspector (CVI), or equivalent. If the HVAC system cleaning contractor is inspecting for microbial contamination they shall also be qualified (through training and experience) and licensed to determine Conditions 1, 2 and 3.

1.4 POST-PROJECT DOCUMENTATION

- A. At the conclusion of the project, if specified in the contract, the HVAC system cleaning contractor shall provide documentation showing compliance with this specification for all work performed. This documentation may include the following:
 - 1. Success of the cleaning project, as verified through visual inspection and/or cleanliness verification.
 - 2. Photo images, HVAC plans and other supporting documents such as submittal forms for materials used and/or warranties or guarantees.
 - 3. System areas found to be damaged and/or in need of repair.

PART 2 PRODUCTS

THIS PART NOT USED.

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PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform an assessment of the HVAC system to determine appropriate engineering controls, safety measures, tools and equipment and cleaning methods required to satisfactorily complete the project.
- B. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION

- A. Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall provide a written work plan including the following information:
 - 1. Scope of Work identifying which HVAC components are to be cleaned, as well as those components not included in the process, along with specific environmental engineering controls required for the workspace, and any unique requirements.
 - 2. Means and methods of cleaning to be used on the project.
 - 3. When applicable, the name of all firms, contractors and representatives involved with the project, along with contact information and the tasks they will be performing.
 - 4. Project schedule outlining dates and times the work will take place and timeframe for completion. The HVAC system cleaning contractor shall be involved in determining the sequence of cleaning within the larger project in order to provide the project schedule.
 - 5. Product submittals listing all general use and/or specific “chemical type” products and coatings specific to the project, along with Safety Data Sheets for all chemical products to be used on the project.
 - 6. Safety plan concerns and defined responsibilities of each organization’s designated representative involved with executing the plan for the duration of the project.

3.3 EQUIPMENT MAINTENANCE AND USE

- A. All HVAC system cleaning contractor equipment shall be maintained in good working order, consistent with applicable jurisdictional requirements.
 - 1. Before any equipment is brought onto the work site it shall be cleaned and inspected to ensure that it will not introduce contaminants into the indoor environment or HVAC system.

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2. All equipment shall be serviced as needed to limit possible cross-contamination from poor hygiene, and/ or unsafe operating conditions for service personnel and building occupants.
3. Any activity requiring the opening of contaminated vacuum collection equipment on-site, such as servicing or filter maintenance shall be performed in an appropriate containment area or outside of the building.
4. All collection devices, vacuums and other tools and devices shall be cleaned or sealed before relocating to different areas of the building and before removing the equipment from building.
5. Fuel-powered equipment shall be positioned in a location to prevent combustion emissions and air exhaust emissions from entering the building envelope. The HVAC system cleaning contractor shall monitor and manage location of equipment to prevent introduction of combustion emissions into the occupied space.
6. When using vacuum collection equipment exhausting within the building envelope, the HVAC system cleaning contractor shall utilize equipment fitted with HEPA filtration and the equipment shall have a collection efficiency of 99.97% at 0.3 micron particle size.

3.4 DISPOSAL OF DEBRIS & CONTAMINATED MATERIALS

- A. All debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state, provincial and local requirements. To prevent cross-contamination, all contaminated materials removed from the HVAC system shall be properly contained prior to removal from the building. Materials deemed to be hazardous by governmental agencies shall be handled in strict accordance with any applicable local, regional or national codes.
- B. Control of Product Emissions: Any application of cleaning agents or other chemicals shall be used in strict accordance with manufacturer's recommended procedures and product application instructions, including exhaust ventilation as required.

3.5 HVAC SYSTEM CLEANING REQUIREMENTS

- A. All cleaning and restoration procedures shall achieve the minimum level of visibly clean or the specified level of cleanliness verification as defined in the contractual documents for components within the project scope of work as defined in NADCA Standard ACR.
- B. Negative Duct Pressurization
 1. Prior to and throughout duration of the cleaning process, the HVAC system and associated air duct shall be kept at an appropriate negative pressure differential relative to the indoor non-work area. This negative pressure differential shall be maintained between the portion of the HVAC duct system being cleaned and surrounding indoor occupant spaces.

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C. Service Openings

1. The HVAC system cleaning contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
2. The HVAC system cleaning contractor shall utilize existing service openings installed in the HVAC system where possible.
3. Service openings installed into the system as needed shall not degrade the structural, thermal, or functional integrity of the system and shall comply with applicable UL, SMACNA and NFPA standards, as well as local, regional, and state codes.
4. Service openings shall be created in a manner that allows for proper closure and shall not hinder, restrict, or alter the airflow within the air duct.
5. Service opening construction materials and methods shall be in compliance with industry standards and local codes, using materials acceptable under those standards and codes.
6. The HVAC system cleaning contractor shall use duct access doors and permanent panels fabricated with materials classified for flammability and smoke spread if the material is exposed to the internal airstream.
7. All tapes used in the installation and closure of service openings shall meet the requirements of UL 181A.
8. Service panels used for closing service openings in the HVAC system shall be of an equivalent gauge or heavier so as to not compromise the structural integrity of the duct.
9. Service panels used for closing service openings shall be mechanically fastened (screwed or riveted) at maximum every 4" on center and equally spaced. The panel shall overlap the duct surfaces by a minimum of 1" on all sides.
10. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
11. Rigid fibrous glass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181A are suitable for fibrous glass duct system closures.
12. Access and closure of service openings installed in fibrous glass shall be created and closed in such a manner that there are no exposed fibrous glass edges within the system common to the airstream.
13. Any fibrous glass removed during the installation of a service opening shall be

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repaired or replaced with like material of the same thickness so that there are no breaks or openings that would degrade the R value, service rating or vapor/air barrier characteristics.

14. All service openings shall be closed with materials meeting UL 181 for smoke generation and flame spread.
15. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and have their location reported to the owner in project report documents.
16. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection and shall be properly reconnected.

D. Cleaning Methods

1. All HVAC components included in the scope of work shall be cleaned by using a suitable agitation device to dislodge contaminants from the HVAC component surface and then capturing the contaminants with a vacuum collection device. Acceptable methods will include those which will not potentially damage the integrity of the duct, nor damage porous surface materials such as liners inside the duct or system components.
2. The included HVAC components shall be cleaned using source removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility.
3. It is the HVAC system cleaning contractor's responsibility to select source removal methods that will render the HVAC system visibly clean and capable of passing cleanliness verification methods as described in NADCA Standard ACR.
4. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
5. Wet cleaning, power washing, steam cleaning and any other form of wet process cleaning of HVAC system components shall not damage or result in subsequent damage to the components. Cleaning agents or water shall never be applied to electrical, fibrous glass or other porous HVAC system components.

E. Particulate Collection

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum collection device shall be connected to the component being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection

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of the indoor environment are assured. When the vacuum collection device is used to convey air with debris, it shall maintain a sufficient velocity and negative pressure differential in the portion of the mechanical system being cleaned.

2. All vacuum devices exhausting air inside the building shall utilize HEPA filtration and the equipment shall have a collection efficiency of 99.97% at 0.3 micron particle size, including hand-held vacuums and wet-vacuums.
3. All vacuum devices exhausting air outside the facility shall be equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

F. Containment

1. Debris removed during cleaning shall be collected and precautions must be taken to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.

G. Controlling Odors

1. Measures shall be employed to control odors and/or mist vapors during the cleaning process.

3.6 COMPONENT CLEANING

A. Cleaning methods shall be employed such that all included HVAC system components must be visibly clean as defined in NADCA Standard ACR.

B. Air Duct Systems

1. Clean air ducts to remove all non-adhered substances so that they are capable of passing NADCA cleanliness verification tests.
2. Access air ducts through service openings in the system that are large enough to accommodate mechanical cleaning procedures and allow for cleanliness verification.
3. Use mechanical agitation methods to remove particulate, debris, and surface contamination.
4. Capture dislodged substances with a vacuum collection device.
5. Not use any cleaning methods that will damage any HVAC components.
6. Mark the position of dampers and any air-directional mechanical devices inside the

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HVAC system prior to cleaning and, upon completion, restore them to their marked position.

7. Verify cleanliness after cleaning has been performed as described in NADCA Standard ACR.

3.7 CLEANLINESS VERIFICATION

- A. All components within the project scope of work shall achieve, at minimum, the level of visibly clean or the specified method of cleanliness verification defined in the contractual documents. Cleanliness verification shall be performed on specified components as described in NADCA Standard ACR.
 1. Cleanliness verification will be performed immediately after HVAC system component cleaning and prior to use in operation.
 2. Cleanliness verification will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- B. Visual Inspection
 1. Visual inspection of porous and non-porous HVAC system components shall be conducted to assess that the HVAC system is visibly clean as defined in NADCA Standard ACR or the specified method of cleanliness verification defined in the contractual documents.
 2. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean.
 3. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

END OF SECTION

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SECTION 23 02 00 - MECHANICAL RELATED WORK

PART 1 GENERAL

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 in the drawings and/or specifications, the contractor shall submit a request for clarification.
- 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. When drilling or cutting concrete floors or other masonry walls, this Contractor shall call the General Contractor or his superintendent of Construction, and inform him of the position and size of the hole or other opening to be provided and the General Contractor

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shall determine how this will be done. Under no condition shall this Contractor make any cuts without permission from the General Contractor, nor shall he cut any green floors or walls.

- C. The Contractor is responsible to verify the location of any and all existing underground utilities in the vicinity of his work. The Contractor shall use appropriate methods including ground penetrating radar, x-ray or utility locating services for all utilities within the scope of the project. The Contractor shall provide adequate means of support and protection during excavation operations for utilities that are to remain in place.
- D. 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.
- E. 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.
- F. 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. See notes on plan for supports to be provided by General Contractor.
- 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:

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1. All piping, ductwork, conduit, steel supports, hangers, and other mechanical items exposed to view in occupied areas shall be painted under Division 09 by General Contractor.
2. All exposed insulated and uninsulated piping and ductwork in Mechanical Room shall be painted by Mechanical Contractor with (2) coats of paint in accordance with Division 09.

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 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.

D. Refer to Division 09 for painting requirements.

PART 2 PRODUCTS

THIS PART NOT USED.

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.

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- B. Form Costing: Cost 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 re-handling 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

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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. Electrical equipment shall be listed and/or labeled by an independent testing agency approved by the State Building Code.
- C. 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.
- 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 VARIABLE FREQUENCY DRIVE CABLE

- A. Manufacturers
 - 1. Belden
 - 2. Southwire
 - 3. Allied Wire and Cable
- B. Cable
 - 1. The cable shall be 600V/1000V rated, 3-phase and 3-ground with stranded tinned copper conductors suitable for use with Variable Frequency Drives. Cable shall be provided with armor per IEEE 1580.
 - 2. The insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature.

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3. Accessories (terminations) shall have ratings that are at least equal to those of the cable. Connectors shall be designed exclusively for VFD cabling.
 4. Cable shall be free from material and workmanship defects.
 5. All cables shall be round.
 6. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial.
- C. Conductor
1. The conductor shall be annealed stranded tinned copper per ASTM B3, B8, and B33.
- D. Insulation
1. The insulation thickness shall have a minimum average wall thickness of 30 mils. The insulation material must be XLPE with a XHHW-2 listing per UL 44.
 2. The insulated conductors are to be cabled together with a minimum of three ground wires. The ground wire(s) are to have a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.
- E. Shielding
1. The cabled assembly shall be shielded using one of two methods:
 - a) Applying helically two 2-mil copper tapes. The shield shall provide 100% coverage over the assembly.
 - b) Applying a 80% minimum coverage tinned copper braid shield used in conjunction with an Aluminum Foil shield tape.
- F. Jacket
1. All cables shall have a continuous overall outer sheath of Polyvinyl Chloride (PVC), suitable for 90°C use.
 2. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant and flame resistant in accordance with UL 1277.
- G. Identification
1. The following permanent legend shall be clearly embossed or printed at approximately 2 foot intervals on the outer jacket for the entire length of the cable:
 - a) Manufacturer's name and or Trade Mark

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- b) Number of conductors and size (-- AWG)
- c) Type of insulation (XLPE) or NEC Listed Conductor Type (XHHW-2)
- d) Voltage rating
- e) TC-ER rating
- f) 1000V Flexible Motor Supply Cable rating
- g) Sequential footage marking at 2 ft intervals

H. Packaging

- 1. Only one continuous (without splices) length of cable shall be shipped on a reel. Both ends shall be waterproof sealed, secured, protected from damage and both ends shall be available for testing.
- 2. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant and flame resistant in accordance with UL 1277.

I. Reel Markings

- 1. The following data, as a minimum, shall be clearly and permanently branded or stamped on metal tags on each side (outside) of each reel flange:
 - a) Manufacturer's name
 - b) Purchaser's name
 - c) Destination
 - d) Contract Number
 - e) Length of cable on reel
 - f) Voltage rating
 - g) Description of cable
 - h) Reel number
 - i) Shipping weight of cable and reel

J. Factory Tests and Reports

- 1. Complete factory tests in accordance with the following shall be performed on all cables and terminations prior to shipment. Prior to start of fabrication, the Manufacturer shall submit for the Owner's approval a complete listing of all routine

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tests and tests to be performed or verified with certification documents. The listing should clearly specify the method of testing and sampling. The cable shall not be shipped unless results of tests show compliance with all requirements of this Specification. The Owner reserves the right to select samples and witness all tests. The Manufacturer shall provide written notification to the Owner at least 3 weeks in advance of the test date. The notice shall include an outline of the procedures used in performance of the tests.

2. All factory tests prescribed by this Specification shall be made at the expense of the Manufacturer. All samples are to be furnished by the Manufacturer. The Manufacturer shall furnish certified test reports for all tests performed.
3. The Manufacturer shall maintain a file of all test reports which shall be fully auditable and accessible to the Owner for a minimum of one year. Upon completion of testing, submit certified report attesting that each test was performed in accordance with the approved test procedures. The report for each test shall include the date of performance and the name of the person in charge of the test.
4. Manufacturer's tests, as well as all tests required by the applicable standards, shall be performed. Tests listed below are representative only and do not constitute all the required tests.
5. Immediately after the factory tests, both ends of each length of cable shall be protected by means of a moisture proof covering. Any end which is left projecting from the drum shall be protected against damage.

2.3 MOTORS

- A. 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.
- B. 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.
- C. 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.
- D. 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

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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.

- E. Motors less than 5 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.
- F. Motors 5 HP and larger shall have efficiencies that comply with NEMA Premium Efficiency ratings.
- G. All vertically mounted motors shall be provided with thrust bearings.
- H. 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.
- I. 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.
- J. Motors that are to be used with adjustable frequency drives shall be approved by the motor manufacturer for that service.
- K. All 3-phase motors shall be provided with lugs.
- L. Construction of Motors Used with Variable Frequency Drives: Motors at a minimum must meet the requirements of NEMA Standard MG 1, section IV, part 31, "Definite Purpose Inverter-Fed Motors". Motors shall be continuous duty and have class F insulation with class B temperature rise.
 - 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application. For frames larger than 280T, provide bearings that can be lubricated. For frames 140T – 280T, provide bearings that can be lubricated or equipped with double shields.
 - 2. Bearings: ANSI/AFBMA L-10 rating of 200,000 hours for direct connected services and shall be capable of being re-lubricated.
 - 3. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 - 4. Service Factor: The service factor shall be at least 1.15 for polyphase motors and 1.35 for single phase motors.
- M. All motors 40 hp and larger not provided with VFD shall be provided with reduced voltage starters.

2.4 STARTERS AND CONTROLLERS

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- 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.

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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.
- 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.
- F. Provide control circuit disconnect for all motor starters as required by Section 430-74 of NEC.

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- 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

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SECTION 23 05 00 – FIRESTOPPING

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 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 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.

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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 fire-stopping sealant manufacturers are acceptable:
1. Nelson
 2. Thomas & Betts
 3. 3M
 4. Hilti
 5. GE
 6. Frye Putty

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 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

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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.

2.3 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 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

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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 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. Terice
- 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,

STEM TYPE THERMOMETERS

- A. Acceptable manufacturers
 - 1. Dwyer
 - 2. Weiss

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3. Weksler
 4. Trerice
- B. Thermometer: ASTM E1, adjustable angle, Hi-impact ABS plastic housing, 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. ½” 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

THERMOMETER SUPPORTS

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

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 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.

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- 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

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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. Cutler Hammer
- C. Danfoss Graham
- D. Or approved equal

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

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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.

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.

- B. 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 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.

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7. Protection against input transients, loss of AC line phase, short circuit, ground fault, over-voltage, under-voltage, drive over-temperature and motor over-temperature.
8. Display all faults in English language. Codes are not acceptable.
9. If the temperature of the drive's heat sink rises to 80°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 its normal switching speed.
10. Fully range minimum and maximum speed adjustment with ability to automatically select speeds as defined in controls sequence.
11. Separately adjustable linear acceleration and deceleration.
12. Field adjustable or automatic current limit.
13. Four short circuit current settings protection.
14. All units shall operate on a 4-20 ma signal in automatic mode.
15. Drive shall communicate with building automation system via LON protocol.
16. Be rated to provide 100% of rated current, minimum 110% break away current.
17. Inverter is to be rated for an input line voltage variation of + 10% and -10%.
18. 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.

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

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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

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SECTION 23 05 29 – SUPPORTS 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.

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.

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

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- 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 hangers. See Section 23 07 00, Insulation.
- B. Hydronic Piping:
 - 1. Conform to MSS SP58.
 - 2. Hangers for Pipe Sizes 1/2 to 1 1/2 Inch): Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 Inches 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 and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6 Inches 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: 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 and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

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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 SLEEVES

A. Sleeves for Pipes Through Non fire Rated Floors: 18 gage galvanized steel.

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.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

C. Place hangers within 12 inches of each horizontal elbow.

D. Use hangers with 1 1/2 inch 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.

3.3 EQUIPMENT BASES AND SUPPORTS

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- A. Provide housekeeping pads of concrete, minimum 6 inches thick and extending 6 inches 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.

3.4 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.

3.5 SCHEDULES

	PIPE SIZE	MAX. HANGER SPACING	HANGER ROD DIAMETER
	<u>Inches</u>	<u>Feet (m)</u>	<u>Inches (mm)</u>
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

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SECTION 23 05 48 - VIBRATION ISOLATION 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 heat recovery chiller.
- 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.

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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.

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- 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 [neoprene isolation pad meeting requirements for neoprene pad isolators] [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.

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- 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

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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.

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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 equipment tag label adjacent to ceiling tack.
- B. Color code as follows (verify with owner prior to installation):
 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 in accordance with Section 09900 for stencil painting.

3.2 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09900, Black on white background.
- D. Install plastic pipe band markers on concealed pipe in accordance with manufacturer's instructions.
- E. Install plastic pipe band markers completely around pipe in accordance with manufacturer's instructions. Bands on 2-1/2" pipe and smaller shall be minimum 2" wide. Bands on 3" pipe and larger shall be minimum 4" wide.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

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- G. 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.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. 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.
- N. 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.
- O. 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

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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 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 week prior to commencing work. Include all pertinent contractors and designers.

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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 system

PART 2 PRODUCTS

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.

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- 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 10 percent of design for air conditioning systems and plus or minus 10 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.

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.

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- 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. Initial building pressure should be 0.02" WG positive with respect to the outside. Adjust building pressure control loop to obtain setpoint. Observe roof membrane periodically to ensure over pressurization is not causing the membrane to visibly 'balloon'.
- 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.

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.

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- 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.

SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing
 - 1. Air-Cooled Chillers
 - 2. HVAC Pumps
 - 3. Chilled Water and Hot Water Coils
 - 4. Air Handling Units
 - 5. Packaged AC Units
 - 6. Fans
 - 7. Air Filters
 - 8. Air Inlets and Outlets
- 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

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- 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

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- g) Starter size, rating, heater elements
 - h) Sheave Make/Size/Bore
5. Air-Cooled Chiller
- a) Manufacturer
 - b) Model
 - c) Compressor HP
 - d) Phase, voltage, amperage, nameplate, actual
 - e) Chilled water flow rates
 - f) Chilled water entering and leaving temperatures
 - g) Chilled Water entering and leaving pressures
6. Condensing Boiler
- a) Manufacturer
 - b) Model
 - c) Phase, voltage, amperage, nameplate, actual
 - d) Hot water flow rates
 - e) Hot water entering and leaving temperatures
 - f) Hot Water entering and leaving pressures
7. 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
8. Pump Data:

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- 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
9. Heat Exchanger:
- a) Identification/number
 - b) Location
 - c) Service
 - d) Manufacturer
 - e) Model number
 - f) Serial number
 - g) Steam pressure, design and actual
 - h) Primary water entering temperature, design and actual
 - i) Primary water leaving temperature, design and actual
 - j) Primary water flow, design and actual
 - k) Primary water pressure drop, design and actual
 - l) Secondary water leaving temperature, design and actual

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- m) Secondary water leaving temperature, design and actual
- n) Secondary water flow, design and actual
- o) Secondary water pressure drop, design and actual

10. 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

11. Heating Coil Data:

- a) Identification/number
- b) Location
- c) Service
- d) Manufacturer
- e) Air flow, design and actual

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- 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

12. 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

13. Outside Air Data:

- a) Identification/location
- b) Design air flow

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- 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

14. Exhaust Fan Data:

- a) Location
- b) Manufacturer
- c) Model number
- d) Serial number
- e) Air flow, specified and actual
- f) Total static pressure (total external), specified and actual
- g) Inlet pressure
- h) Discharge pressure
- i) Sheave Make/Size/Bore
- j) Number of Belts/Make/Size
- k) Fan RPM

15. Duct Traverse:

- a) System zone/branch

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- 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

16. Duct Leak Test:

- a) Description of ductwork under test
- b) Duct design operating pressure
- c) Duct design test static pressure
- d) Duct capacity, air flow
- e) Maximum allowable leakage duct capacity times leak factor
- f) Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
- g) Test static pressure
- h) Test orifice differential pressure
- i) Leakage

17. Air Monitoring Station Data:

- a) Identification/location

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- b) System
- c) Size
- d) Area
- e) Design velocity
- f) Design air flow
- g) Test velocity
- h) Test air flow

18. Flow Measuring Station:

- a) Identification/number
- b) Location
- c) Size
- d) Manufacturer
- e) Model number
- f) Serial number
- g) Design Flow rate
- h) Design pressure drop
- i) Actual/final pressure drop
- j) Actual/final flow rate
- k) Station calibrated setting

19. Terminal Unit Data:

- a) Manufacturer
- b) Type, constant, variable, single, dual duct
- c) Identification/number
- d) Location
- e) Model number

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- f) Size
- g) Minimum static pressure
- h) Minimum design air flow
- i) Maximum design air flow
- j) Maximum actual air flow
- k) Inlet static pressure

20. Air Distribution Test Sheet:

- a) Air terminal number
- b) Room number/location
- c) Terminal type
- d) Terminal size
- e) Area factor
- f) Design velocity
- g) Design air flow
- h) Test (final) velocity
- i) Test (final) air flow
- j) Percent of design air flow

END OF SECTION

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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.

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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.
 - b) Pump casings below 60° service: 1-1/2" thick.
 - c) Run-outs to terminal units and split refrigerant systems: 1-1/2" thick.

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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 and low pressure steam piping:
 - 1) 1-1/2 inch diameter and smaller hot water and steam piping: 1-1/2" thick.
 - 2) Above 1-1/2 inch hot water piping: 2" thick.
 - b) Domestic cold water make-up piping (inside building): 1/2- inch thick.
 - c) Tanks: 2"

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.

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6. Apply on:
 - a) Chilled Water piping: 1" thick.
 - b) Chilled water specialties, except those insulated with flexible foam: 1" thick.

2.2 MATERIALS FOR DUCTS

A. Blanket Type Insulation

1. Provide minimum 1.5 pound per cubic foot density, flexible, factory reinforced glass fiber blanket with foil-faced, glass-fiber reinforced kraft vapor barrier jacket.
2. Insulation to have a minimum installed "R" value of 8.0.
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. Insulating board to have a minimum "R" value of 8.00.
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.

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- 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 shall approve pipe when cleaned and painted.
 - 2. All chilled 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 tanks, heat exchangers, insulated equipment and pipes 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.
 - 4. 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.
 - 5. For any service when above grade and exposed to the weather outside building, cover pipe insulation with 0.016-inch thick aluminum jacket.
 - 6. Do not insulate valves in systems operating above 60 degrees F. Paint valves with a rust-resistant product equivalent to Rustoleum.
 - 7. 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".
 - 8. Aluminum jacketing shall be manufactured from aluminum alloy 0.016 inch thick and have a factory lined vapor barrier with a smooth finish in accordance with

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ASTM B209. Accessories including edge-safe strapping, seals, fasteners, aluminum fitting jackets, adhesives, etc., shall be compatible with jacketing and shall be furnished by the same manufacturer furnishing jacketing. Aluminum jacketing shall be banded on 8" centers with 3/8" wide, 0.15 thick aluminum metal jack bands.

B. Ducts

1. In Mechanical Rooms and where exposed to view: provide an additional layer of Kraft paper jacket with vapor sealing tape followed by an 8 oz/sq. yd. canvas cloth treated with fire retardant lagging adhesive. Reinforce corners. Finish by painting with two coats of latex based paint. Color shall match the existing ductwork in the surrounding area or as determined by the Owner.
2. Outdoor ducts exposed to view shall have a field applied jacket. Jacket shall be aluminum, smooth finish with 0.025" thickness.

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.

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- 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.

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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.

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- 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 23 05 00.

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.

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- 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 sides.

END OF SECTION

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SECTION 23 09 00 - BUILDING MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Normally Supplied But Installed by Others:
 - 1. Control valves.
 - 2. Flow switches.
 - 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic control dampers, where not supplied with equipment or by mechanical.
- B. Products Not Furnished or Installed But Integrated with the Work of This Section:
 - 1. Smoke detectors (through alarm relay contacts). Fire alarm system monitoring only by BMS system.
- C. Work Required Under Other Divisions Related to This Section:
 - 1. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 2. Campus LAN (Ethernet) connection adjacent to Network Area Controller (JACE).
 - 3. Smoke control system installation.

1.3 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over a BACnet/MSTP open protocol bus. Controllers shall be of one manufacturer and the latest version as of the date of the bid.
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework. This may be a new system or an expansion.
 - 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
 - 3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 - 4. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 - 5. The N4 supervisor shall be a PC with minimum Intel Xeon CPU E5-2640 (or better) with 16 GB RAM 2 (256GB) SSD hard drives in a RAID 1 configuration.

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It shall include a minimum 32X CD-ROM drive and 4-USB 3.0 ports. A minimum 21", HDMI, DVI-D video interfaces, minimum 1024 x 768 resolution, 4x3 Widescreen, LED color monitor with a minimum 60 Hz refresh rate shall also be included.

The N4 supervisor operating system shall be Windows 10 PRO 64 bit for workstation grade hardware and Windows Server 2016 for server grade hardware as a minimum. Utilize latest OS compatible with latest release of Niagara N4. Remove all other OS entries. Workstation and Server grade must be identified by the manufacturer and not a designer designation.

- a. With VM support
 - b. With the most recent service packs and system updates.
 - c. Selected based on availability and project requirements.
 - d. Acceptable Manufacturers are:
 - a) Dell
 - b) Lenovo
 - c) HP (Hewlett Packard)
 - e. Connection to the BAS LAN network shall be via an Ethernet network interface card, 1Gb LAN.
 - f. The N4 supervisor shall support all Network Control Units (NCU), OWSs, and 3rd party mechanical / electrical systems connected to the Facility Management Control / Building Automation System Local Area Network.
 - g. N4 supervisor to include Niagara 4 license as required to accommodate all DDC controllers and control points provided for this project.
 - h. Include 5-year SMA (Software Maintenance Agreement). Labor for software maintenance is not included. NOTE: a 5 year SMA is required.
6. The JACE shall handle the communications and licenses and be provided by the contractor. A rack mounted supervisor and license will be purchased and installed by others. The integrator shall be responsible for the entire site integration.
 7. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system computer, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 8. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 9. All NAC hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
 10. All NAC provided as part of this project shall be the appropriate JACE-8000 model licensed with all necessary drivers.
 11. All NAC's provided as part of this project shall be licensed to accommodate a minimum of 10% additional controllers and points.
 12. Access: The owner will be granted permanent full administrative access to the entire system with no limitations or expiring licenses or renewals required. This access level allows the ability to add and/or delete accounts.

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1.4 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 2. AI: Analog Input.
 3. AO: Analog Output.
 4. Analog: Continuously variable state over stated range of values.
 5. BMS: Building Management System.
 6. DDC: Direct Digital Control.
 7. Discrete: Binary or digital state.
 8. DI: Discrete Input.
 9. DO: Discrete Output.
 10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 12. GUI: Graphical User Interface.
 13. HVAC: Heating, Ventilating and Air Conditioning.
 14. IDC: Interoperable Digital Controller.
 15. ILC: Interoperable Lon Controller.
 16. LAN: Local Area Network.
 17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
 18. Motorized: Control device with actuator.
 19. NAC: Network Area Controller (JACE).
 20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
 21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
 22. OSC: Operating System Computer, host for system graphics, alarms, trends, etc.
 23. Operator: Same as actuator.
 24. PC: Personal Computer.
 25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
 26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
 27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
 28. PICS: BACnet Product Interoperability Compliance Statement.
 29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).

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30. Point: Analog or discrete instrument with addressable database value.
31. SMA: Software Maintenance Agreement. Maintenance agreement that provides future releases of Niagara 4 software at no licensing cost to owner. Labor to implement software upgrades is not covered under the Software Maintenance Agreement.
32. WAN: Wide Area Network.

1.5 PRELIMINARY DESIGN REVIEW

- A. The BAS contractor shall submit a preliminary design document for review within 45 days of the NTP. This document shall contain the following information:
 1. Provide the graphic block programming tool to be used and relevant supporting documentation to ensure compliance with Part 3 of this specification.
 2. Provide the web page graphic tools to be used to develop the web pages consistent with our latest standards.
 3. Provide a description of the proposed system along with a system architecture diagram with the intention of showing the contractors solution to meet this specification and samples of graphics consistent with NCDPS latest design guidelines attached to and made part of this project.
 4. Provide product data sheets and a technical description of all direct digital controller hardware required to meet specifications listed herein.
 5. Provide an overview of the BAS contractor's local/branch organization, local staff, recent related project experience with references, and local service capabilities.
 6. Provide information on the BAS contractor's project team including project organization, project manager, project engineer, programmers, project team resumes, and location of staff.
- B. Coordinate a meeting with a control team project manager, programmer, design engineer, and owner to review sequences within that time. NCDPS Central Engineering Electronics Engineering Group shall receive notification and invitation to this meeting. Offer concerns or suggestions for improvement.

Agenda items for the meeting:

 1. Sequences
 2. Trends to be set up
 3. Alarms and required delays/buffers to avoid nuisance alarms.
 4. Review procedures for BACnet equipment startup by manufacture and understanding interfacing for control and monitoring. BACnet points numbers and names will be coordinated. Points to be viewed and how will be discussed. The mechanical contractor will be responsible for having an equipment control expert knowledgeable on the specific equipment at the meeting.

1.6 SUBMITTALS

- A. Submit under provisions of Division 1 specifications.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.

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3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
 - D. The control system submittal shall consist of shop drawings, manufacturers' catalog data sheets and installation instructions. Submit in electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
 - E. As a minimum, shop drawings shall contain:
 1. A table of contents.
 2. Equipment schedules.
 3. Valve and damper schedules when applicable. Valve schedules shall include GPM, valve size, calculated Cv, valve Cv, pressure drop, close-off pressure, configuration (2-way or 3-way), and valve actuator data.
 4. VAV box controller schedule. Schedule shall include box size, K-Factor, and flow setpoints.
 5. Schematic diagrams of all controlled equipment.
 6. Sequences of operation for all controlled equipment. To be written in a more programming style than engineer's narrative sequence. Do not cut and paste engineer's sequence.
 7. Controller wiring diagrams, including terminal number identification for all control wiring.
 8. Wiring details for all field devices.
 9. A network architecture diagram showing a high-level overview of the installed system.
 10. A detailed control system bus layout depicted on building floorplans. Indicate controller locations.
 11. Control panel layout diagrams depicting all panel mounted components.
 12. Any other details required to demonstrate that the system has been coordinated with other trades and will properly function as a system.
 13. Manufacturer's data sheets for all installed components.
 - F. All system manuals available to the controls vendor shall be provided to the owner as submittals to permit full networking, installation, programming, graphic generation, and checkout of the installed system. As a minimum but not limited to the following. Failure to provide these manuals shall result in rejection of the submittal in toto:
 1. Operator's Manuals
 2. Programming Manuals
 3. Graphic Creation and Integration Manuals
 4. Niagara Platform Manuals
 5. Module Installation, Diagnostic
 - G. Upon completion of the work, provide 3 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and one electronic copy.
 - H. Any deviations from these specifications or the work indicated on the drawings shall be

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clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within [150] miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. The Control System Contractor shall be staffed with a minimum of ten (10) Niagara 4 certified software engineers and/or technicians. The Control System Contractor shall also be staffed with a minimum of ten (10) control system manufacturer certified software engineers and/or technicians. The Control System Contractor shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. **Single Source Responsibility of Supplier:** The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 3 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop. Control panels shall be assembled such that all necessary I/O points are pre-wired from DDC controllers to terminal blocks. Wire ducts shall be installed within the panel as needed to accommodate field wiring.
- C. **Equipment and Materials:** Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.
- D. **Preferred Brand Alternate No. 1:** Distech ECB Series.
- E. **Familiarity with working environment:** The DDC contractor and the wiring sub-contractor on retro-fit jobs must be acquainted with working in a prison environment. They must have proof of having experience or training and follow all requirements set by NCDPS.

1.8 SOFTWARE OWNERSHIP

- A. The Owner (NCDPS Central Engineering) shall have full ownership and full access rights for all network management, operating system computer, engineering and programming software required for the ongoing maintenance and operation of the BMS.
- B. Contractor shall provide a complete backup of programs, graphics, and documentation, in an editable format without password restriction (other than what is inherently required by the controller or equipment. In that case, password shall be provided.)

1.9 DELIVERY, STORAGE AND HANDLING

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- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein. An N4 supervisor is to be on site for graphic storage and trending data storage and located on a new rack mount by Central Engineering Staff as noted above.
- B. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet, IP, or MS/TP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant BMS computer database is required for all system database parameter storage. This data shall reside on the N4 supervisor located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

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- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORK AREA CONTROLLER (NAC)

- A. Basis of design is the JACE- 8000. These controllers are designed to manage communications between the Advanced Application Controllers (B-AAC), Application Specific Controllers (B-ASC) and Advanced Unitary Controllers (AUC) which are connected to its communications trunks, manage communications between itself and other system network controllers (NAC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The JACE shall be an embedded controller and server platform for connecting multiple and diverse devices and subsystems, internet connectivity, webserving capability, integrated control, supervision, data logging, alarming, scheduling and network management. Data and graphical displays shall be streamed to a standard network browser via Ethernet or wireless LAN, or remotely over the internet. The operating system shall be EC-Net 4 web-based building management platform powered by the Niagara Framework.
- C. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- D. The controllers shall be capable of peer-to-peer communications with other NAC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- E. The communication protocols utilized for peer-to-peer communications between NAC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between NAC's is not allowed.
- F. The NAC shall employ a device count capacity license model that supports expansion capabilities.
- G. The NAC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. Lon
 - 3. MODBUS
 - 4. SNMP

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5. KNX

H. The NAC shall be capable of executing application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of LonWorks, BACnet, and MODBUS controller data.
7. Network management functions for all NAC, PEC and ASC based devices.

I. The NAC 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 DDR3 SDRAM 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°C Ambient Operating Temperature
9. Integrated 24 VAC/DC Global Power Supply
10. MicroSD Memory Card Employing Encrypted Safe Boot Technology. Minimum 4GB flash and total storage/2GB user storage.
11. Have a USB type A port for station backup and restore functions
12. Backward compatibility to run an EC-Net station (minimum requirement is 3.8.111)
13. Platform:
 - a. Processor T1 AM3352 1000MHz ARM® Cortex™ -A8
 - b. Removable micro-SD card with 4GB flash total storage/2GB user storage
 - c. Real-time clock
 - d. Batteryless
 - e. Secure boot
14. Operating System:
 - a. EC-Net 4 4.1 or later
 - b. EC-NetAX 3.8.111 or later
 - c. EC-Net Access 2.3.118 or later
15. Communications: Wi-Fi Client or WAP
16. Wi-Fi Communication Protocol:
 - a. IEEE802.11 a/b/g/n
 - b. IEEE802.11 n HT20 @ 2.4GHz
 - c. IEEE802.11n HT20/HT40@5GHz
17. Client Authentication Method: WPAPSK/WPA2PSK support

(2) Ethernet 10/100MB Ethernet ports

BACnet Listing BTL, B-BC listed with version 4.4.93 or latest

MTTF: 10 years+

J. The NAC shall support standard Web browser access via the Intranet/Internet. It shall

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support a minimum of 16 simultaneous users.

- K. The NAC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- L. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Mobile device text message.
 - d. Pagers via paging services that initiate a page on receipt of email message.
 - e. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the NAC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- M. The NAC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- N. The NAC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- O. The NAC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms, etc. that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AVAV, CVAV, VFD's, etc.) shall have an associated template file for reuse on future project additions.
- P. The NAC shall be provided with a Software Maintenance Agreement as indicated in Paragraph 1.3.

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- A. HVAC control shall be accomplished using BACnet based devices where the application has a BTL Listed PICS defined. The controller platform shall provide options and advanced system functions, programmable and configurable using the Niagara 4 Framework or through manufacturer supplied software, that allow standard and customizable control solutions required in executing the "Sequence of Operation". For systems that do not provide the ability to program DDC controllers through the Niagara 4 Framework, provide (4) copies of controller engineering/programming software, including any necessary licenses required for use of software.
- B. While BACnet is the selected communications platform there may be cases where Lonworks will be utilized on system expansions or renovations. All DDC controllers shall incorporate a common hardware platform between the BACnet and Lonworks communication models. Model I/O options and termination layouts shall be identical regardless of communication option selected.
- C. All controllers shall include a network connection for local viewing of operation, AHU, FCU, UV, VAV for example.
- D. DDC controller manufacture shall offer both custom programmable controllers and plug-and-play pre-configured application specific controllers.
- E. DDC controller manufacturer shall offer models with built in LCD with live color graphics for operator interface directly to controller. [Designer to confer with NCDPS Controls team to determine whether this will be included as a requirement, estimated add is \$75.]
- F. DDC controllers shall utilize a graphical block oriented programming interface tool. This software tool shall license free and not require any reoccurring costs for continued operation.
- G. All controllers shall have sufficient input and output capability for the terminal system being controlled and monitored plus allow two spare inputs and outputs, VAV box controllers require one set. Plant controllers to have min of 10% spare capacity. Controller enclosure shall be size to accommodate a second controller of the same size.
 - 1. Advanced Application Controller (B-AAC) - a controller designed for more complex sequences of operations such as built up AHU's, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The B-AAC's are to allow for the flexibility of custom control programming to meet the needed sequences of operation. B-AAC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All B-AAC's shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the B-AAC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The B-AAC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. B-AAC's shall have mixture of I/O including dry contact digital inputs,

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- universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).
2. Advanced Variable Air Volume Controller (AVAV) - a controller designed specifically for room-level VAV control - pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals and constant volume dual-duct terminal unit.
 - a. The AVAV shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the PEC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The AVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. AVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.
 3. Configurable VAV Controller (CVAV) - the configurable VAV controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO₂, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, series fan powered terminal unit, parallel fan powered terminal unit, supply and exhaust air volume terminals, and constant volume dual-duct terminal unit.
 - a. The CVAV shall be application specific configuration and shall at all times maintain their certification. All control sequences within or programmed into the CVAV shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The controller shall have an internal velocity pressure sensor.
 - c. The CVAV shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - d. CVAV's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).
 - e. The controller shall provide an integrated actuator option.

H. UV, FCU Controller

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1. Advanced Application Controller (AAC) - a controller designed for more conventional sequences of operations such as small AHUs, fan coil units, unit ventilators with real time clock, 8 analog outputs, 10 universal inputs,. AAC's are to allow for the flexibility of custom control programming to meet the needed sequences of operation. AAC's shall be selected based upon I/O requirements. Additional I/O may be added via expansion modules.
 - a. All AAC's shall be application programmable and shall at all times maintain their certification. All control sequences within or programmed into the AAC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
 - b. The AAC shall provide LED indication of communication and controller performance to the technician, without cover removal.
 - c. AAC's shall have mixture of I/O including dry contact digital inputs, universal inputs (configurable as of 4-20 mA, 0-10 VDC, thermistor and RTD in the range 0 to 350,000 ohm), universal outputs (4-20mA, 0-10 VDC, or digital), and digital outputs (24 VAC TRIAC).

2.5 DDC Sensors and Point Hardware

A. Temperature Sensors

1. Acceptable Manufacturers: Veris, Distech, Honeywell, ACI
2. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.
3. Room Sensor: Standard space sensors shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series
 - a. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
 - b. Where a local display is specified, the sensor shall incorporate an LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons, operators shall be able to adjust setpoints directly from the sensor.
4. Duct Probe Sensor: Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Useable in air handling applications where the coil or duct area is less than 14 square feet. Basis of Design: Veris TD Series
5. Duct Averaging Sensor: Averaging sensors shall be employed in ducts which are larger than 14 square feet. The averaging sensor tube shall contain at least one thermistor for every 3 feet, with a minimum tube length of 6 feet. The averaging sensor shall be constructed of rigid or flexible copper tubing. Basis of Design: Veris TA Series
6. Pipe Immersion Sensor: Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Provide sensor probe length suitable for application. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells shall be stainless steel for non-corrosive fluids below 250 degrees F

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and 300 series stainless steel for all other applications. Basis of Design: Veris TI Series

7. Outside Air Sensor: Provide the sensing element on the building's north side. Sensing element shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure. Operating range -40 to 122 F, Basis of Design: Veris TO Series
8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Wall Transmitter

1. Acceptable Manufacturer: Veris, Distech, Vaisala, Hy-Cal, Honeywell
2. Transmitters shall be accurate to +/- [1] [2] % at full scale.
3. Transmitter shall have replaceable sensing element.
4. Sensor type shall be thin-film capacitive.
5. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
6. Operating range shall be 0 - 100% RH noncondensing, 50 to 95 F
7. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC.
8. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
9. Transmitter shall be available in an [off white] [black] enclosure made of high impact ABS plastic for mounting on a standard electrical box.
10. Transmitter shall have LCD display
11. Transmitter shall be available with a certification of NIST calibration
12. [Transmitter shall have integrated temperature sensor]
13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter

1. Acceptable Manufacturer: Veris, ACI, Vaisala, Hy-Cal, Honeywell
2. Transmitters shall be accurate to +/- [1] [2] % at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe.
4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall be available with a certification of NIST calibration
11. [Transmitter shall have integrated temperature sensor]
12. Basis of Design: Veris HD Series

D. Humidity Outdoor Transmitter

1. Acceptable Manufacturer: Veris, ACI, Vaisala, Hy-Cal, Honeywell
2. Transmitters shall be accurate to +/- 2% at full scale.
3. Transmitter shall be fully encapsulated in potting material within a stainless steel probe. Probe shall be encased in PVC solar radiation shield and mounted in a weatherproof enclosure.

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4. Transmitter shall have replaceable sensing element.
5. Sensor type shall be thin-film capacitive.
6. Sensor element shall contain multipoint calibration on-board in nonvolatile memory
7. Operating range shall be 0 - 100% RH noncondensing, -40 to 122 F
8. Output shall be 4-20 mA or 0-5/0-10 VDC.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
10. Transmitter shall be available with a certification of NIST calibration
11. [Transmitter shall have integrated temperature sensor]
12. Basis of Design: Veris HO Series

E. Carbon Dioxide Wall Transmitter:

1. Acceptable Manufacturer: Veris, Honeywell, Distech
2. Sensor type shall be Non-dispersive infrared (NDIR).and gold plated optics shall be provided.
3. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm.
4. Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value
5. Response Time shall be <60 seconds for 90% step change
6. Outputs shall be field selectable [Analog: 4-20mA or 0-5/0-10VDC] [Protocol: Modbus or BACnet] with [SPDT Relay 1A@30VDC] [temperature setpoint slider]
7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: [32° to 122°F (CO2 only)] [50° to 95°F (with humidity option)]
9. Output range shall be programmable 0-2000 or 0-5000 ppm
10. Transmitter shall be available in an [off white] [black] enclosure for mounting on a standard electrical box.
11. Transmitter shall have LCD display for commissioning and provide additional faceplate to conceal LCD display where occupants may misinterpret CO2 readings.
12. Calibration method: Self calibration method eliminates the need for manual calibration and calibrates the sensor based on baseline calibrations measured during unoccupied periods in the space. Sensor shall not require manual calibration over a minimum product rated life of 15 years.

F. Carbon Dioxide Duct Transmitter:

1. Acceptable Manufacturer: Veris, Honeywell, Distech
2. Sensor type shall be Non-dispersive infrared (NDIR) and provide gold plated optics.
3. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Calibration method: Self calibration method eliminates the need for manual calibration and calibrates the sensor based on baseline calibrations measured during unoccupied periods in the space. Sensor shall not require manual calibration over a minimum product rated life of 15 years.
4. Repeatability shall be ± 20 ppm $\pm 1\%$ of measured value
5. Response Time shall be <60 seconds for 90% step change
6. Outputs shall be field selectable Analog: 4-20mA or 0-5/0-10VDC with SPDT Relay 1A@30VDC

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7. Transmitter shall accept 12-30 VDC or 24 VAC supply power.
8. Temperature Range: 32° to 122°F
9. Output range shall be programmable 0-2000 or 0-5000 ppm
10. Enclosure shall not require remote pickup tubes and make use of integrated H-beam probe to channel air flow to sensor.
11. Enclosure lid shall require no screws and make use of snap on features for attachment
12. Enclosure shall be made of high impact ABS plastic
13. Transmitter shall have LCD display

G. Air Pressure Transmitters.

1. Acceptable Manufacturers: Veris, Distech, KMC, Modus, Dwyer, BAPI
2. Sensor shall be microprocessor profiled ceramic capacitive sensing element
3. Transmitter shall have 14 selectable ranges from 0.1 – 10” WC
4. Transmitter shall be +/- 1% accurate in each selected range including linearity, repeatability, hysteresis, stability, and temperature compensation.
5. Transmitter shall be field configurable to mount on wall or duct with static probe
6. Transmitter shall be field selectable for Unidirectional or Bidirectional
7. Maximum operating pressure shall be 200% of design pressure.
8. Output shall be field selectable 4-20 mA or 0-5/0-10 VDC linear.
9. Transmitter shall accept 12-30 VDC or 24 VAC supply power
10. Response time shall be field selectable T95 in 20 sec or T95 in 2 sec
11. Transmitter shall have an LCD display
12. Units shall be field selectable for WC or PA
13. Transmitter shall have provision for zeroing by pushbutton or digital input.
14. Transmitter shall be available with a certification of NIST calibration
15. Basis of Design: Veris model PXU.

H. Liquid Differential Pressure Transmitters:

1. Acceptable Manufacturers: Veris, Setra, Kele, Rosemount, Foxboro
2. Transmitter shall be microprocessor based
3. Transmitter shall use two independent gauge pressure sensors to measure and calculate differential pressure
4. Transmitter shall have 4 switch selectable ranges
5. Transmitter shall have test mode to produce full-scale output automatically.
6. Transmitter shall have provision for zeroing by pushbutton or digital input.
7. Transmitter shall have field selectable outputs of 0-5V, 0-10V, and 4-20mA.
8. Transmitter shall have field selectable electronic surge damping
9. Transmitter shall have an electronic port swap feature
10. Transmitter shall accept 12-30 VDC or 24 VAC supply power
11. Sensor shall be 17-4 PH stainless steel where it contacts the working fluid.
12. Performance:
 - a. Accuracy shall be ±1% F.S. and ±2% F.S. for lowest selectable range
 - b. Long term stability shall be ±0.25%
 - c. Sensor temperature operating range shall be -4° to 185°F
 - d. Operating environment shall be 14° to 131°F; 10-90% RH noncondensing
 - e. Proof pressure shall be 2x max. F.S. range

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- f. Burst pressure shall be 5x max. F.S. range
 13. Transmitter shall be encased in a NEMA 4 enclosure
 14. Enclosure shall be white powder-coated aluminum
 15. Transmitter shall be available with a certification of NIST calibration
 16. [Transmitter shall be preinstalled on a bypass valve manifold]
 17. Basis of Design: Veris PW
- I. Current Sensors
1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturers: Veris, Kele
- J. Current Status Switches for Constant Load Devices
1. Acceptable Manufacturers: Veris, RE Technologies
 2. General: Factory programmed current sensor to detect motor undercurrent situations such as belt or coupling loss on constant loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory.
 3. Visual LED indicator for status.
 4. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 0.5 A to 175 A.
 5. Normally open current sensor output. 0.1A at 30 VAC/DC.
 6. Basis of Design: Veris Model H608.
- K. Current Status Switches for Constant Load Devices (Auto Calibration)
1. Acceptable Manufacturer: Veris, RE Technologies
 2. General: Microprocessor based, self-learning, self-calibrating current switch. Calibration-free status for both under and overcurrent, LCD display, and slide-switch selectable trip point limits. At initial power-up automatically learns average current on the line with no action required by the installer
 3. Split core sensor, induced powered from monitored load and isolated to 600 VAC rms. Sensor shall indicate status from 2.5 A to 200 A.
 4. Display: Backlit LCD; illuminates when monitored current exceeds 4.5A
 5. Nominal Trip Point: $\pm 40\%$, $\pm 60\%$, or on/off (user selectable)
 6. Normally open current sensor output. 0.1A at 30 VAC/DC.
 7. Basis of Design: Veris Model H11D.
- L. Current Status Switches for Variable Frequency Drive Application
1. Acceptable Manufacturer: Veris, RE Technologies
 2. General: Microprocessor controlled, self-learning, self-calibrating current sensor to detect motor undercurrent and overcurrent situations such as belt loss, coupling shear, and mechanical failure on variable loads. Sensor shall store motor current as operating parameter in non-volatile memory. Push-button to clear memory and relearn.
 3. Visual LED indicator for status.
 4. Alarm Limits: $\pm 20\%$ of learned current in every 5 Hz freq. band
 5. Split core sensor, induced powered from monitored load and isolated to 600 VAC

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- rms. Sensor shall indicate status from 1.5 A to 150 A and from 12 to 115 Hz.
6. Normally open current sensor output. 0.1A at 30 VAC/DC.
 7. Basis of Design: Veris Model H614.
- M. Liquid Flow, Insertion Type Turbine Flowmeter:
1. Acceptable Manufacturer: Onicon, Hersey
 2. General: Turbine-type insertion flow meter designed for use in pipe sizes 1 1/2" and greater. Available in hot tap configuration with isolation valves and mounting hardware to install or remove the sensor from pipeline that is difficult to shut down or drain
 3. Performance:
 - a. Accuracy $\pm 1\%$ of rate over optimum flow range; ≥ 10 upstream and ≥ 5 downstream straight pipe diameters, uninterrupted flow
 - b. Repeatability $\pm 0.5\%$
 - c. Velocity Range: 0.3 to 20 FPS
 - d. Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
 - e. Pressure Rating: 1000 psi @ 70°F
 4. Maximum Temperature Rating: 300°F
 5. Materials: Stainless Steel or Brass body; Stainless steel impeller
 6. Transmitter:
 - a. Power Supply: 12 - 30VAC or 8 - 35VDC.
 - a) Output: [Frequency] [4-20 mA] [Scaled Pulse]
 - b. Temperature Range: 14° to 150°F
 - c. Display: 8 character 3/8" LCD (Optional)
 - d. Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover
- N. Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on):
1. Acceptable Manufacturers: Veris, Onicon
 2. General: Clamp-on digital correlation transit-time ultrasonic flow meter designed for clean liquids or liquids containing small amounts of suspended solids or aeration. Optional temperature sensors for BTU calculations.
 3. Liquid: water, brine, raw sewage, ethylene, glycol, glycerin, others. Contact manufacturer for other fluid compatibility
 4. Pipe Surface Temperature: Pipe dia 1/2" to 2": -40-185°F; Pipe dia > 2": -40-250°F
 5. Performance:
 - a. Flow Accuracy:
 - a) Pipe dia 1/2" to 3/4" 1% of full scale
 - b) Pipe dia 1" to 2" 1% of reading from 4-40 FPS
 - c) Pipe dia 2" to 100" 1% of reading from 1-40 FPS
 - b. Flow Repeatability $\pm 0.01\%$ of reading
 - c. Velocity Range: (Bidirectional flow)
 - a) Pipe dia 1/2" to 2" 2 to 40 FPS
 - b) Pipe dia 2" to 100" 1 to 40 FPS
 - d. Flow Sensitivity 0.001 FPS
 - e. Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F

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- f. Temperature Sensitivity: 0.05°F
- g. Temperature Repeatability: ±0.05% of reading
- 6. Transmitter:
 - a. Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC.
 - b. Output: [RJ45] [Modbus TCP/IP] [Ethernet/IP] [BACnet/IP] [Pulse] [4-20 mA] [RS-485 Modbus RTU]
 - c. Temperature Range: -40 to +185°F
 - d. Display: 2 line backlit LCD with keypad
 - e. Enclosure: NEMA 4, (IP65), Powder-coated aluminum, polycarbonate
- 7. Agency Rating: UL 1604, EN 60079-0/15, CSA C22.2, CSA Class 1 (Pipe > 2")
- 8. Basis of Design: Veris FST & FSR series

- O. Analog Electric/Pneumatic Transducer:
 - 1. Acceptable Manufacturers: Veris, ACI, RE Technologies
 - 2. General: Micro-controlled poppet valve for high accuracy and with no air loss in the system. Field configurable for pressure sensing in multiple applications.
 - 3. Power Supply: 22-30VDC, 20-30VAC
 - 4. Control Input: 4-20mA, 0-10V, 0-5V; jumper selectable
 - 5. Performance:
 - a. Accuracy: 1% full scale; combined linearity, hysteresis, repeatability
 - b. Compensated Temperature Range: 25° to 140°F
 - c. Temp Coefficient: ±0.05%°C
 - d. Operating Environment: 10-90% RH, non-condensing; 25° to 140°F
 - 6. Supply Pressure: 45 psig max.
 - 7. Manual Override: Jumper selectable mode, digital pushbutton adjust
 - 8. Alarm Contact: 100mA@30VAC/DC (Optional)
 - 9. Control Range 0-20 psig or 3-15 psig; jumper selectable
 - 10. Pressure Differential 0.1 psig (supply to branch)
 - 11. Pressure Indication Electronic, 3-1/2 digit LCD
 - 12. Housing: Mounted on standard SnapTrack; Optional clear dust cover
 - 13. Basis of Design: Veris EP Series

- P. Control Valves
 - 1. Acceptable Manufacturer: Belimo
 - 2. Provide automatic control valves suitable for the specified controlled media (steam, water or glycol). Use characterized ball valves for 2" and under, heating valves fail open. Cooling valves fail closed unless otherwise noted. Provide NEMA 3 enclosure where subject to moisture. Provide valves which mate and match the material of the connected piping. Equip control valves with 24VAC modulating actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification.
 - 3. Control valves and actuators shall be from the same manufacturer.
 - 4. Control valves shall meet the heating and cooling loads specified, and close off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10 to 100% of the maximum design flow. CV to be approximately ½ of GPM.

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5. Trim material shall be stainless steel for steam and high differential pressure applications.
6. Electric actuation should be provided on all terminal unit reheat applications unless electric heat is provided.

Q. Damper Actuators

1. Acceptable Manufacturer: Honeywell, Belimo, Distech
2. Damper actuators shall be Belimo electronic, and shall be direct coupled over the shaft, without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered. Control damper actuators shall be furnished by the Control System Contractor. Provide a minimum of 5 in-lb torque per square foot of damper area. All applications requiring proportional operation shall utilize truly proportional electric actuators. Only actuators with proven equal or lesser failure rate will be considered.

R. Airflow Measuring Stations

1. Acceptable Manufacturers: Ebtron, Tek-air Systems
2. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.
3. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

2.6 OTHER CONTROL SYSTEM HARDWARE

- A. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- B. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Approved manufacturers: JCI, Dynacon
- C. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- D. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."

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- E. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- F. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.7 N4 SUPERVISOR & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The N4 supervisor shall communicate using Ethernet and TCP. N4 supervisor shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The N4 supervisor software shall support at least the following platforms (Windows 10 Pro 64bit and Windows Server 2016). The N4 supervisor software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.
 - 8. Parameter change of properties.
 - 9. Set point adjustments.
 - 10. Alarm / event information.
 - 11. Configuration of operators.
 - 12. Execution of global commands.
 - 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:

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1. N4 supervisor Software, Database and Web Browser Graphical User Interface.
 2. Software Maintenance Agreement license as specified. Labor to implement future upgrades is not included.
 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 4. Embedded Graphical Programming Tools.
 5. Embedded Application Software.
- F. N4 supervisor Database: The N4 supervisor software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Edge/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 2. Secure Socket Layers: Communication between the Web Browser GUI and N4 supervisor shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.8 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events. The Department of Adult Corrections (DAC) is moving towards a standard, clean look and feel for their graphics across all buildings and sites to ensure users can most effectively utilize this tool. Part 3 specifies how these graphics are to look and feel.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed

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simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.

1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 2. Groups View shall display Scheduled Groups and custom reports.
 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree, including current parameter values.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. High Resolution Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs, .png, or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:

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1. Display Size: The GUI workstation software shall graphically display in a minimum of 1920 by 1200 pixels 32 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
 6. Color Coding for Piping:

a. Steam Supply:	Steel gray with red letters and arrows
b. Steam Condensate Return:	Steel gray with orange letters and arrows
c. Chilled Water Supply:	Royal blue with baby blue letters and arrows
d. Chilled Water Return:	Royal blue with orange letters and arrows
e. Condenser Supply:	Light blue with red letters
f. Condenser Return:	Light blue with orange letters
g. Hot Water Supply:	Red with orange letters and arrows
h. Hot Water Return:	Red with baby blue letters and arrows
i. Geothermal Supply:	Aqua with red arrows
j. Geothermal Return:	Aqua with blue arrows
k. Dual Temperature Supply:	Cyan with Red & royal blue letters/arrows
l. Dual Temperature Return:	Cyan with Orange & light blue letters/arrows
m. Natural Gas Piping:	Safety Yellow
n. Domestic Water, Cold:	Green with light blue letters/arrows
o. Domestic Water Hot:	Green with red letters/arrows
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

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1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities: Alarms are to be set up to not be a nuisance but be instructive and will require tuning based on feedback during the warranty period.
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event

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templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.

2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the N4 supervisor database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the N4 supervisor software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the N4 supervisor's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value

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- in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.

- H. Trends: As system is engineered, all hard-wired points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
 - 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the N4 supervisor if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and ' pan through' historical data by simply scrolling the mouse.
 - 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 - 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
 - 8. Access: The owner will granted permanent full Administrative access to the entire system with no limitations or expiring licenses or renewals required. This access level allows the ability to add and/or delete accounts.

- I. Security Access: Systems that Security access from the web browser GUI to N4 supervisor shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
 - 1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.

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- b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.9 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.

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4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.10 BACNET NETWORK MANAGEMENT

- A. Systems requiring the use of third-party BACnet network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing BACnet network, regardless of what network management tool(s) were used to install the existing network, so that existing BACnet devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 EXECUTION

3.1 WORK INCLUDED

- A. Install the system as specified above and herein, and, along with the other supporting documents attached to and made part of this specification including representative page by page web graphics.

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1. Provide a Tier 1 Graphical Interface Package. (Package shall comply will all requirements of the BMS Graphical Standards. See Appendix A.)
 2. This package consists of:
 - a. Page by Page layouts
 - b. Navigation menus.
 - c. Control Status for each equipment system
 - d. Control Parameters for each equipment systems
 - e. Standard trends
 - f. Input/Output points listings
 - g. Sequence of Operations
 - h. Alarms and Analytics
- B. Graphics: All local graphics and system access shall be integrated into the existing state rack mounted station located at NCCIW. Operators to this site will have full access, control, programming, graphic capabilities, etc.to modify the system in its entirety from this access.
- C. System Graphics: The look, layout and feel of the work station graphics shall to the best degree possible mimic what is provided in the attached Graphics package and therefore part of this specification. This includes the menu and submenu structures reflected therein. However, this is intended as a guideline and not an exact representation of what is needed on each screen. As a minimum:
1. The workstation/graphics shall provide full access via the Niagara platform to all underlying system modules, data, parameters, programming, etc.
 - a. The Site Graphic shall consist, as a minimum, of the menu format indicated on both the vertical and horizontal plane. If additional information is available, provide under the appropriate menu selection.
 - b. Provide links to the O&M manuals, specifications and drawings as indicated in the graphics package.
 - c. All O&M manuals shall be electronically archived, and bookmarked by section and product. Owner shall have the chance to review and request the contractor make final changes to the bookmarks, bookmark structure, and, bookmark names.
 2. The system graphics (AHUs, zones, Boiler Plant, etc.) are representative in nature and need to be modified specific to this system.
 3. The representative Properties pages and information are a minimum that is to be provided with the ability to manipulate setpoints, limits, calibration, etc. as a minimum and with the appropriate access level.
 4. All other data points are to be modifiable from the block programming pages.
 5. The contractor is to coordinate with the customer (Electronics Controls Group-ECG) for access privileges. This group and Energy Management (EM)are to be provided the highest level access. There shall be no proprietary data. As a minimum:
 - a. Level 10 (highest/Administrator)
 - a) Test and balance parameters
 - b) Hysteresis
 - c) Minimum start and stops

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- d) Ramp up and ramp downs
 - b. Sequencing enables shall be at the next highest level.
 - c. Provide the owner (ECG & EM) Administrator passwords at the initial sit down to discuss the submittals and proposed graphics.
 - d. The site user shall have a password that allows them to lock valves and dampers, and change room setpoints.
- D. Point Names and Name Tagging: Shall be provided as identified in the Input and Output points listed in the design drawings and therefore made part of this specification. All name tagging shall comply with the Haystack protocol.
- E. Function Block programming standards:
- 1. Programming shall only be through Only Function Block programming is permissible for programming.
 - 2. Each “line” of block programming will be numbered to allow easy means of tracking of the logic (like a ladder diagram).
 - a. The block programming shall be divided into submodules such as:
 - a) Occupancy
 - b) Fan Control
 - c) Cooling Control
 - d) Heating Control
 - e) Damper Control
 - f) Alarm & Safety
 - g) Outside dependencies such as heating and cooling requests
 - b. Each submodule shall be clearly identified as to function and the sequence of operation provided as text to simplify referencing between the code and sequence of operation required.
 - 3. Connectors & Tags
 - a. Connectors shall have reference “tags” to allow that line of logic/data to support submodule programming as needed. These tags will be referenced by the ladder line number for easy tracking.
 - 4. PID Loop Control: Control Loops shall be PID loop controls with appropriate PID parameters to reach and maintain setpoint with minimal offset/error.
 - 5. Hysteresis: All thresholds/setpoints shall have hysteresis or dead band values to prevent constant resetting of setpoints up or down.
 - 6. Setpoint Ramp Ups/Downs: All significant changes in setpoint adjustments shall be ramped up/down to prevent wild swings in PID loop controls
- F. Reports:
- 1. Provide a report listing all variables that have been overridden, modules that have failed or are no longer communicating, and equipment that has been commanded on, but status indicates off. Provide a summary and then a detailed list. See below:
 - a. # Points overridden: 3
 - b. # Modules not communicating: 3 of 13
 - c. # of Systems commanded on but status indicates Off
 - d. List of a.
 - e. List of b.
 - f. List of c.

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2. Emails are to be sent to designated staff at Central Engineering
- G. Trending:
1. “Standing” trends shall be provided as identified in the Graphics Package. These shall be set up “permanently” so the user does not have to create their own trends on the fly. The contractor is to meet with the Energy Manager to determine what will be shown on these standing trends.
 2. Provide the ability to enter custom dates to access historic data and provide trends accordingly.
 3. If available, provide a sliding bar that allows the user to simply slide the bar like a fast forward or fast reverse to access historic or current trend data.
 4. On they fly trend capability shall also be provided. The owner shall be capable of saving these custom trends for future use and not have to reenter point and other relevant information.
- H. Alarms: Alarms shall be set up as defined in the Alarms, Analysis and Energy Diagnostics tables. All alarm messages are to be populated as identified in these tables.
- I. Initial Meeting:
- a. Provide the owner the Administrative passwords and demonstrate the owner has full access to all aspects of the system. (The Owner’s Representative in this case will be NC Department of Public Safety Central Engineering representatives intimately familiar with the design guidelines and standards, and, BMS operations. As a minimum this will be either an individual from the Electronics Controls Group Team, Energy Management or both):
 - b. Describe to the satisfaction of the Owner’s Representative the following
 - a) The owner has full rights and privileges to programming, graphic development, data access, etc.
 - b) Representative graphics and similarity to the graphics provided as part of this package.
 - c) Representative graphic programs documented as required above.
 - d) How the algorithm for Optimal Start and Stop will successfully be accomplished.
 - e) Representative standard trends as required by the attached graphics package, and how integrated into graphic displays.
 - f) Point-by-Point test sheets that will be used for each system type.
 - g) Training to be provided by the contractor and as outlined herein.
- J. Mid Meeting: The contractor shall meet with ECG and/or EM as integration begins to ensure the above standards continue to be met.
- K. Seasonal Changes: The night setback temperatures and Optimal Start Stop parameters will be reviewed by the contractor during the cooling, and, during the heating season to ensure the HVAC systems can recover in time for Scheduled Occupancy and energy savings can be attained. This will be demonstrated via the Standard Trends. Particular care will be paid to setbacks for the weekend conditions since the HVAC systems could be off for extended periods of time. The contractor is to discuss these changes with ECG or EM before proceeding with the review, and, before making the changes.

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- L. Weather Conditions: Provide local weather conditions shall be obtained from the most local weather stations including Temperature, Humidity, Dewpoint, and rainfall.
- M. Zones shall have their own unitary control module as identified within this document.
- N. AHUs will have their own controller.
- O. The chiller and boiler plants may utilize one controller equal to the ECB-600 controller and its compatible expansion controllers.
- P. BACnet Cards: All data from equipment including but not limited to chillers, boilers, variable speed drives, and package units shall have BACnet cards installed. All data from the BACnet module shall be accessible to the customer from the graphical interface. The contractor is to coordinate with ECG or EM to discuss how the presentation of this information via the graphical interface.
- Q. Analytics: As an alternate, provide the analytics as identified within the specification package.

3.2 Balance

- A. The VAV TCU shall also provide an air flow balancing tool.
- B. This tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
- C. Systems not able to provide a web based air balance tool or a portable air flow balancing interface or an Intelligent Space Sensor (ISS) capable of balancing air flow as part of the VAV TCU controller shall provide an individual full time technician during the air flow balancing process to assure full balance compliance.

3.3 Control contractor shall provide a local computer to record trends and store graphics not stored on the Jace. Contractor to run Ethernet cable in conduit to location of owner's internet access for final termination by owner.

3.4 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.5 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

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- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.
- E. Location of controllers to be approved by Owner prior to installation.

3.6 WIRING

- A. All control wiring to the control panels shall be the responsibility of the Control System Contractor. 120 VAC wiring to control panels shall be provided by Control Contractor from nearest panel with spare capacity unless otherwise noted to be by Electrical Contractor. 120 VAC surge protector to be provided and installed by Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways. All conduit installed by controls contractor shall be blue.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. All wires shall be labeled on each end with professional labeling system using label printer Brady Model BMP41 or equivalent using labels designed for wire marking. Labels shall indicate connection point on each end of wire.
- E. Incorporate electrical noise suppression techniques in relay control circuits.
- F. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- G. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- H. Use manufacturer-specified wire for all network connections. LON network cable jacket shall be blue. Network cable for integration of RS-485 BACnet or Modbus devices shall have an orange jacket.
- I. All Input/Output cable shall have a yellow jacket. All output wiring shall be 18 gauge, minimum. All input wiring shall be 22 gauge minimum.
- J. Use approved optical isolation, fiber optic converters, and lightning protection when penetrating building envelope.
- K. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.7 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all

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necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results are achieved. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation. Sample Point-by-point test sheets to be provided at the 45 day meeting. Completed pages shall be sent to the owner as they are completed. Specifically:
 - 1. Provide a point by point test. That ensures the following occurs. Means and methods will be by the contractor for confirmation of the following:
 - a. Disconnect or short sensor as appropriate. Observe failure. Document alarm condition. Document reading on HVAC System Graphic, and, Properties page. Confirm failure mode. Upon sensor reaching status, calibrate.
 - 2. Logic testing: Describe the logic to be tested and the desired outcome. Confirm operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.
- D. Perform commissioning test where required.

3.8 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Contractor shall provide 8 total hours of training in two 4-hour sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the second class is to be in the last month of 1-year warranty period.
- C. Training shall be hands on and not the operator sitting in front of the computer while the trainee observes from behind. As a minimum:
 - 1. Trainee shall successfully and independently perform a point by point testing for at least two (2) of each type of points in the system.
 - 2. Trainee shall successfully demonstrate the ability to enter a schedule for a zone, and a group of zones at least three times.
 - 3. Trainee shall successfully be able to discuss how optimal start/stop works, night setback, hot and chilled water reset. They will also demonstrate an understanding of how the building envelope and its dynamics will impact optimal start/stop, and

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night setback limits.

4. Contractor will create at least four scenarios where the HVAC system fails to work properly, and the trainee successfully tracks down the issue. As a minimum include:
 - a. A Valve or control point locked on.
 - b. A failed sensor.
 - c. Heating system failure
 - d. Cooling system failure.

- D. Control System Contractor shall select the DDC controller platform currently used by NCDPS and with NCDPS Central Engineering Electronics Group having technical personnel certified on the selected platform. Control System Contractor will be required to provide manufacture certified training to 4 NCDPS employees if no employees are currently certified on the selected platform for this job.

3.9 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of two years from the time of system acceptance (not startup).
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a Software Maintenance Agreement as defined in section 1.3. All NAC and N4 supervisors are included in this coverage.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.10 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

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3.11 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum and include all requirements as identified in Section 1.6 Submittals:
- B. As a minimum, shop drawings shall contain:
 - 1. A table of contents.
 - 2. Equipment schedules.
 - 3. Valve and damper schedules when applicable. Valve schedules shall include GPM, valve size, calculated Cv, valve Cv, pressure drop, close-off pressure, configuration (2-way or 3-way), and valve actuator data.
 - 4. VAV box schedule. VAV box schedule shall include box size, K-Factor, and flow setpoints.
 - 5. As-built schematic diagrams of all controlled equipment.
 - 6. Final sequences of operation for all controlled equipment.
 - 7. As-built controller wiring diagrams, including terminal number identification for all control wiring.
 - 8. As-built wiring details for all field devices.
 - 9. As-built network architecture diagram showing a high-level overview of the installed system.
 - 10. As-built control system bus layout depicted on building floorplans.
 - 11. As-built control panel layout diagrams depicting all panel mounted components.
 - 12. Completed Performance Verification sheets.
 - 13. Completed Controller Checkout/Calibration Sheets.
 - 14. Manufacturer's data sheets for all installed components.

3.12 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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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. Gate valves.
 - 2. Globe or angle valves.
 - 3. Ball valves.
 - 4. Butterfly valves.
 - 5. 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.

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- 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 Brazing 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.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder, wrought copper.

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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 tube as specified above
- 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. Shut-off valves shall be ball valves 2” and under and shall be butterfly valves 2-1/2” and larger.
- C. 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

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8" and larger; screw or gear operator. All butterfly valves shall be "lug" type for bolting to a standard flange.

- D. 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.

- E. 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

- F. 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

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- G. Swing Check Valves 0 - 2" - 150# bronze
 - 1. Body - Bronze
 - 2. Disc - Bronze
 - 3. Hammond IB 904, Nibco T-433 or Victaulic equivalent
- H. 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
- I. 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 23 25 00

3.2 INSTALLATION

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

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- B. All chilled, hot, and water source piping shall be hydrostatically tested for pressure of 1-1/2 times the working pressure of the line, but not less than 100 psig for a minimum period of 24 hours. This hydrostatic test shall be witnessed by the Designer.
- 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.

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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, welded joints of grooved.
 3. Steel pipe 4" and larger, welded or flanged joints, or grooved.
 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 construction.
- 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.

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3.3 SCHEDULES

A. Pipe Hanger Spacing.

PIPE SIZE	MAX. HANGER SPACING	DIAMETER
<u>Inches</u>	<u>Feet</u>	<u>Inches</u>
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

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SECTION 23 21 16 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Pump suction fittings.
- F. Flow indicators, controls, meters.
- G. Pressure Reducing Valves.
- H. Relief valves.
- I. Flexible coupling.

1.2 QUALIFICATIONS

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

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- B. Provide pre-charged steel expansion tank with replaceable heavy duty Butyl rubber bladder/diaphragm.
- C. 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.

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.

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.

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 (minimum 60 mesh).
- B. Size 2-1/2 inch to 4 inch:
 - 1. Y-pattern with flanged iron body for 175 psig working pressure, flanged ends, bolted cover, basket pattern with 1/8 in stainless steel perforated screen and bottom drain connection.

PUMP SUCTION FITTINGS

- A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psig working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable fine mesh strainer to fit over cylinder strainer, and permanent magnet located in flow stream and removable for cleaning.
- B. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

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

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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.

PRESSURE REDUCING VALVE

- A. Iron body, low inlet pressure check valve, removable strainer. 125 psi working pressure.

RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

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.

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- G. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- H. Select equipment relief valve capacity to exceed rating of connected equipment.
- I. Pipe relief valve outlet to nearest floor drain.

END OF SECTION

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SECTION 23 21 23 – PUMPS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish and install centrifugal type pumps with the following characteristics:
 - 1. End Suction Pumps
 - 2. Centrifugal Inline Pumps
 - 3. Flexible coupled.
 - 4. Bronze fitted.
 - 5. Non-overloading.
 - 6. 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 BASE MOUNTED PUMPS:

- A. Manufacturers:
 - 1. Bell & Gossett
 - 2. Taco
 - 3. Armstrong
 - 4. Approved Equal
- B. Construction: Construction of horizontal, split-case pumps shall conform to the following requirements:

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1. Casing (with drains and vents): Cast iron conforming to ASTM A48 with the upper and lower halves bolted together. Flanged suction and discharge connections are located in the lower half of the casing. The casing is supported by integral cast feet. The casings shall have two lifting lugs, two tapered dowel pins for alignment, and a .030" parting gasket. Separate bearing housings are attached to machined fits in each end of the casing cap screws.
2. Impeller: Enclosed double suction- type to provide hydraulic balance, exterior surfaces machined and interior waterways hand finished. Statically and dynamically balanced, keyed to the shaft, one-piece Bronze casting to ASTM B84 C87600.
3. Impeller and Case Wear Rings: Casing wear rings designed to maintain proper running clearance and to minimize leakage between suction and discharge chambers of the casing. Each ring is held in position by two anti-rotation pins, located in milled slots at the horizontal parting surface. Renewable Case Wear Rings shall be Bismuth Bronze ASTM B584 C80500. The impeller wear rings are held in position by axial set screws, Renewable Impeller Wear rings shall be Bronze ASTM B584 C87600
4. Shaft: The shaft is a heavy duty design to minimize deflection and vibration. The shaft deflection is a maximum of 0.002 inches at the stuffing box faces under the worst operating conditions. Shafting shall be Steel ASTM A322 Grade 4140.
5. Shaft Sleeves: When applicable shaft sleeves shall be keyed at the impeller end, held axially by threaded sleeve nuts and shall be Bronze ASTM B584 C80500.
6. Mechanical Seals: larger bore stuffing boxes shall be furnished to provide an improved environment and greater sealing flexibility. Seal water piping from volute for treated water pumps.
7. Bearings: Heavy duty, grease-or oil- lubricated double row ball thrust bearings and a single row of deep groove ball bearing at the coupling end. Minimum L10 Bearing life of 50,000 hours at any point within the operating range.
8. Bearing Housing: The thrust bearing is held in position with tapered snap rings and is locked in the thrust bearing housing to take any unbalanced axial thrust load. The radial bearings are free to float axially in the bearing housings taking radial loads only. The bearing housings are completely sealed with labyrinth oil seals to exclude moisture and dirt.
9. Seal Tubing: Carbon Steel
10. Baseplate: Baseplate shall be cast iron with a drip collection chamber, tapped drain connection and opening for grouting.

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- C. An ANSI B15.1 and OSHA 1910.219 compliant coupling guard shall shield the coupler during operation. Coupler guard shall be dual designed and contain viewing windows for inspection of the coupling. No more than 0.25 inch opening in the guard around the rotating assembly shall be visible.
- D. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve. Motors at a minimum must meet the requirements of NEMA Standard MG 1, section IV, part 31, "Definite Purpose Inverter-Fed Motors". Motors shall be continuous duty and have class F insulation with class B temperature rise.
- E. Pump rotation shall be right-hand or left-hand as viewed from the pump's motor end and in respect to the discharge flange.
- F. Pump shall be of a maintainable design for ease of maintenance and should use machine fit parts that are easily disassembled.
- G. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 1.1-1.5, section 1.4.6.1.1 for recommended acceptable unfiltered field vibration limits (as measured per HI 1.4.6.5.2, Figure 1.108) for pumps with rolling contact bearings. Pump manufacturer shall be ISO-9001 certified.
- H. Each pump shall be hydrostatically tested and painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.

2.2 CENTRIFUGAL VERTICAL IN-LINE PUMPS

- A. Manufacturers:
 - 1. Bell & Gossett
 - 2. Taco
 - 3. Armstrong
 - 4. Approved Equal
- B. 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.
- C. 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

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- of pump casing provided with air vent cocks. Where pumps are insulated, extend vent cocks outside insulation.
- D. All pumps one horsepower and large shall have impellers cut to provide capacities called for.
 - E. 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 Volume X current edition.
 - F. Fully bronzed fitted with enclosed impellers dynamically balanced. Bronze wearing ring or impeller runners provided on the suction side of the impellers.
 - G. Shafts stainless steel.
 - H. 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.
 - I. Motor sized not to overload at any point within the operating range of impeller and piping system.
 - J. Provide and install combination starter with circuit breaker to match motor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installer must examine areas and conditions under which pumps shall be installed, and 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 to operate at specified system fluid temperatures without vapor binding and cavitations are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- D. Install long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump castings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.

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- E. 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.
- F. Provide air cock and drain connection on horizontal pump casings. Provide drains for bases and seals.
- G. Provide drains for bases and seals.
- H. Manufacturer's representative shall be required to provide alignment of motor and pump, a laser alignment tool is required for this service, motor and shaft shall be aligned within 0.002 (in) according to mechanical seal manufacturer. A printout of correct alignment shall be provided to the Engineer.

3.2 FIELD QUALITY CONTROL

- A. Section 23 05 93- Execution Requirements: Testing, adjusting, and balancing.
- B. Inspect for alignment of base mounted pumps
- C. Upon completion of installation of pumps, and after motors have been energized with normal power source, bleed air from pump casings and test pumps to demonstrate compliance with requirements. Where possible, field correct malfunctioning units, and then retest to demonstrate compliance. Replace units which cannot be satisfactorily correct. Touch up scratches on finished surfaces to restore finish with paint provided by the manufacturer.
- D. Inspection, Startup, and Field Adjustment: The service representative of the Manufacturer shall be present at the site for 1 work day, to furnish the services required by manufacturer for safe start-up and for instruction of OWNER'S personnel

END OF SECTION

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SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. This section includes all pipe, pipe fittings, hangers and supports, etc., as may be required to provide a complete refrigerant piping system.
- B. Testing of all piping shall be made in the presence of the Engineer or a designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.
- C. The actual arrangement of the piping shall follow the general locations shown on the drawings such that clearances, line drainage, etc. shall be maintained.

PART 2 - PRODUCTS

2.1 PIPING

- A. Refrigerant piping shall be Type "ACR" hard drawn copper conforming to ANSI B-31.5 or ASTM B280.
- B. Condensate drain piping shall be Type "L" hard drawn copper conforming to ASTM B-88.

2.2 PIPING FITTINGS

- A. Copper pipe fittings shall be wrought metal solder joint type and brazed conforming to ANSI B16.22.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping:
 - 1. The installation of piping and related items shall be made neatly and in such a manner as not to interfere with access to valves or equipment. Expansion, drainage and maintenance of installed piping shall be possible.

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2. All piping shall be reamed to remove all burrs, fins and foreign material. Pipe shall be thoroughly cleaned before soldering.
3. "Sil-Fos" or silver solder shall be used with non-corrosive flux. During the soldering operation, the pipe shall be purged with nitrogen.
4. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, one-half inch in diameter larger than the pipe or insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves through exterior walls shall be caulked and made watertight.

B. Hangers and Supports:

1. The spacing of hangers and supports shall not exceed five feet.
2. Pipe covering protection saddles shall be used at all supports for insulated piping. Sheet metal shields shall be 10 gauge, three times the diameter of the pipe and minimum of twelve inches long.

C. Testing:

1. All refrigerant equipment not tested at the factory shall be shut off from the rest of the system and tested under a vacuum with no evidence of leakage. Piping systems shall be tested after installation, and before any insulation is applied. All controls and other apparatus that may be damaged by the test pressure shall be removed before tests are made.
2. Refrigerant lines shall be tested at 150 psi on low side and at 300 psi on high side per ASA Standard B9.1. System shall be tested with an inert gas of dry nitrogen or dry carbon dioxide. Pressure limiting or pressure reducing valves and gauges on outlet side of tanks shall be used to reduce the tank pressure of the inert gas to the pressure specified above. Pressure shall be maintained for 30 minutes without loss of pressure. If loss of pressure occurs during this time, system shall be checked with halide torch and any leaks repaired. Test shall then be rerun for another 30-minute period. Testing and repair shall continue until there is no loss of pressure. After a satisfactory pressure test, high vacuum pumps (DO NOT USE COMPRESSOR) shall be connected to the system and the system evacuated to a pressure of 0.20 inches of mercury with the system ambient temperature at not less than 36 degrees Fahrenheit. After this has been attained, the vacuum pump shall be valved off from the system for a period of not less than twelve hours. The vacuum shall be broken by charging system with the refrigerant vapor as soon as possible.

END OF SECTION 23 23 00

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SECTION 23 23 10 - REFRIGERANT PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section includes the expansion valve, solenoid valve, filter drier and miscellaneous items required for a complete refrigeration system.

PART 2 - PRODUCTS

2.1 STRAINER

- A. Refrigerant strainer shall be T-Type, 80 mesh Monel screen, solder connections, UL Listed, Henry Model 896-S or approved equal by Alco, Cash.

2.2 EXPANSION VALVE

- A. Expansion valves shall be diaphragm actuated, external equalizer, adjustable, suitable for refrigerant and capacity specified, replaceable thermostatic element, UL listed, soldered connections, Henry 629 Series or approved equal by Alco, Cash.

2.3 SOLENOID VALVE

- A. Solenoid valve shall be Series A, soldered connections, suitable for refrigerant and capacity specified, rated for electrical voltage available, UL listed, Henry or approved equal by Alco, Cash. Install in liquid line.

2.4 SIGHT GLASS

- A. Sight glass shall be single port, soldered connections, positive color contrast, factory assembled, self-contained, removable cap, polished optical glass, protected moisture element, Henry, type M1-30-S or approved equal by Alco, Cash. Line size.

2.5 FILTER DRIER

- A. Filter drier shall be factory assembled, sealed, UL listed, suitable for refrigerant and capacity specified, soldered connections, Henry "H" Series, or approved equal by Alco, Cash. One per solenoid valve.

PART 3 - EXECUTION

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3.1 INSTALLATION

- A. All refrigerant piping specialty items shall be installed per manufacturer's recommendations.
- B. Gauges or other instruments shall not be installed until piping has been cleaned and tested.

END OF SECTION 23 23 10

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SECTION 23 25 00 - CHEMICAL WATER TREATMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years of experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.
- B. For the first year, tests shall be monthly and additional treatment added as the tests indicate the need. All labor and material furnished by the contractor at no charge to the owner during this period.
- C. Provide laboratory and technical assistance services during this maintenance period.

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- D. Include two hour training course for operating personnel, instructing them on maintenance and operation of water treatment systems. Arrange course at startup of systems.
- E. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.7 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.

2.2 BY-PASS (POT) FEEDER

- A. Quick opening cap for working pressure of 175 psig.

PART 3 EXECUTION

3.1 PREPARATION

- B. 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.

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- C. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- D. Place terminal control valves in open position during cleaning.
- E. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Concentration:

- 1. As recommended by chemical feed company.

B. Chilled and Hot Water Systems:

- 1. Circulate for 48 hours and then drain systems as quickly as possible.
- 2. Within one hour of draining, 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 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION

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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:

Provide the following information for each sealant system furnished on the Project:

1. Sealant name and type.
2. Sealant system design pressure.
3. Duct material.
4. Duct gage.
5. Transverse joint methods.
6. Longitudinal seam type.

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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. 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°F to 200°F.
- C. 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.
- D. 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.

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5. Operating Temperature: -20° to 200°F
 6. Thermal Conductance: .23 @ 75°F.
- E. Fasteners: Rivets, bolts, or sheet metal screws; stainless steel for stainless steel ductwork.
- F. Sealants:
1. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
 2. Basis of Design: Hardcast
 3. Sealant shall be water based latex UL 181A-M, B-M reinforced sealant conforming to the product specifications.
 4. Sealant shall be water based latex UL 181 B-M non-reinforced sealant conforming to the product specifications.
 5. 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
- G. 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.

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- 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. Double wall insulated round ducts downstream of terminal boxes: Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 1" thick fiberglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.
- D. 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.
- E. Transverse Duct Connection System:

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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.
- F. Double Wall Insulated Duct
1. Insulation (1” thick; refer to Duct Liner Insulation in Section 23 07 00) with solid 20ga. outer liner and 22 ga. inner perforated liner tack welded to support channels. All steel surfaces, channels and trim to be galvanized steel (G-60).
 2. Inner liners shall be perforated with 3/32” holes.
 3. Each panel shall be completely filled with noncombustible, mildew resistant insulation with flame spread no greater than 25 and smoke development no greater than 50. Thermal conductance no greater than 0.06 at a mean temperature of 75 deg. F.
 4. Provide all structural components, beams and columns, necessary to support second level of equipment.
 5. Joint construction shall be tongue and groove.

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. Provide access door at all locations requiring service access.

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 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”
- C. Duct sizes on plans are inside clear sizes.

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- D. 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. All 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. 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.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- F. Use double nuts and lock washers on threaded rod supports.
- G. 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.
- H. Connect flexible ducts to metal ducts with adhesive and draw bands. Use sheet metal screws for positive pressure over 2”.
- I. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust or weather from entering ductwork system.
- J. 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 plenums and accessible ducts in Equipment Rooms 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
Low Pressure Supply (HVAC Systems and downstream of terminal units)	2 inch
Medium Pressure Supply (upstream of terminal units)	6 inch
All Other Ducts	2 inch

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END OF SECTION

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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 BACKDRAFT DAMPERS

- A. Manufactures:
 - 1. Ruskin Manufacturing Co.

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2. Arrow
 3. United Emertech
 4. Kinetics Noise Control
- B. Gravity backdraft dampers furnished with air moving equipment may be air moving equipment manufacturer's standard construction.
- C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: galvanized steel, extruded aluminum, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, and plated steel pivot pin adjustment device to permit setting for varying differential static pressure.

2.3 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.

2.4 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.

2.5 VOLUME CONTROL DAMPERS

- A. Manufactures:
1. Ruskin Manufacturing Co.
 2. Arrow
 3. United Emertech
- 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.

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- 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 backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- D. Provide duct test holes where indicated and required for testing and balancing purposes. Neoprene plugs.
- E. Install automatic dampers in manner directed by Controls Sub-Contractor.
- F. 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.
- G. 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

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SECTION 23 34 00 - POWER VENTILATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Inline Centrifugal.
- B. Roof Exhausters.
- C. Motors and drives.
- D. Fan accessories.

1.2 RELATED SECTIONS

- A. All Sections Apply.

1.3 REFERENCES

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- C. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal.
- E. AMCA 301 Method for Calculating Fan Sound Ratings from Laboratory Test Data.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Protect motors, shafts, and bearings from weather and construction dust.

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1.7 EXTRA MATERIALS

- A. Supply two sets of belts for each fan.

PART 2 - PRODUCTS

2.1 INLINE CENTRIFUGAL

- A. Manufacturer:
 - 1. Greenheck.
 - 2. Other acceptable manufacturers offering equivalent products:
 - a. Greenheck.
 - b. Cook.
 - c. Twin City.
- B. Impeller: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans. Motor pulleys shall be adjustable for system balancing. Factory wiring shall be provided from motor to the handy box.
- C. Frame: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on two sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
- D. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- E. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.
- F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure.
- G. Isolators: Provide hanging spring isolators.

2.2 BEARINGS AND DRIVES

- A. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.

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- B. V Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
- C. Belt Guard: Fabricate to SMACNA Standards; of 12-gauge, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of lubrication, and use of tachometer with guard in place.
- D. Lubrication: Extend lubrication fittings to outside of casing.

2.3 ACCESSORIES

- A. Straightening Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to match casing.
- B. Inlet Screens: Galvanized steel welded grid to fit inlet.
- C. Dampers: Welded steel construction, consisting of two semicircular vanes pivoted on oil retaining bearings in short casing section, finished with one coat enamel.
- D. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

2.4 ROOF VENTILATORS, SUPPLY, AND EXHAUST

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Other acceptable manufacturers offering equivalent products:
 - a. Greenheck.
 - b. Cook.
 - c. Twin City.
- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2-inch mesh, 16 gage aluminum bird screen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 16-inch-high self-flashing of aluminum with continuously welded seams, built in cant strips one inch insulation, and factory installed nailer strip.
- D. Electrical Characteristics and Components, Single Phase Motors”
 - 1. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 - 2. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid-state speed controller.
- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.

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- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position.
- G. Fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install fans as indicated. Install with resilient mountings and with flexible electrical leads.
- C. Install flexible connections specified in between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- D. Provide fixed sheaves required for final air balance.
- E. Provide safety screen where inlet or outlet is exposed.
- F. Provide ceiling suspended units with support brackets bolted to casing flange.
- G. Fan operation will be under the responsibility of fan manufacturer and will be monitored by controls contractor.

END OF SECTION 23 34 00

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SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.2 REFERENCES

- A. ARI 650 - Air Outlets and Inlets.
- B. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- C. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.3 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

PART 2 PRODUCTS

- 2.1 See plans for grille and diffuser schedule.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and structural limitations.
- C. Connect diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, grille or register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

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SECTION 23 63 13 – OUTDOOR, AIR-SOURCE HEAT PUMP UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work to this section.

1.2 SCOPE

- A. Provide material, equipment, labor, and supervision necessary to install air-cooled condensing units.
- B. Unit ratings, capacities, and characteristics shall be as scheduled on Mechanical Drawings.

1.3 REFERENCES

- A. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment
- B. ASHRAE 14 - Measurement of Energy and Demand Savings
- C. ASHRAE 15 - Safety Standard for Refrigeration Systems
- D. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- E. STM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
- F. Performance shall be in accordance with the applicable ARI Standards.
- G. Compressor motors, starters, wiring, and control wiring shall all conform to NEMA, UL, NEC, and local utility requirements.

1.4 SECTION INCLUDES

- A. Condensing unit package
- B. Charge of refrigerant and oil
- C. Controls and control connections
- D. Refrigerant piping connections
- E. Motor starters
- F. Electrical power connections

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
- C. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.
- D. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

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1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 77 00.
- B. Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. Protect units on site from physical damage.

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1.8 WARRANTY

- A. Provide 5-year extended replacement warranty (parts and labor) on compressor, condenser coils, fans, controls, electrical devices and related system components.

1.9 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process.
- B. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority.
- C. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure.
- D. Refer to Section 01 77 00 - Contract Closeout, for substantial completion details.
- E. Refer to Section 01 91 00 - Commissioning, for detailed commissioning requirements

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide products by one of the following:
 - 1. Trane
 - 2. York
 - 3. Daikin
 - 4. Engineer and Owner approved equal.

2.2 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
- B. Construction and Ratings in accordance with ARI 210/240
 - 1. Testing shall be in accordance with ASHRAE 14
- C. Provide energy Efficiency Rating EER of not less than 10.3 or as prescribed by ASHRAE 90A and the FBC: Energy Conservation, whichever is highest.
- D. See Schedule on Drawings for unit capacities, electrical characteristics, and performance criteria.
- E. Provide unit with a holding charge of refrigerant and oil.

2.3 CASING

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- A. House components in welded frame with steel panels with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors.
- C. Provide removable access doors or panels with piano hinges and quick fasteners.

2.4 CONDENSER COILS

- A. Coils
 - 1. Aluminum plate fins mechanically bonded to seamless copper tubing.
 - 2. Provide sub-cooling circuits.
 - 3. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of refrigerant
- B. All condenser coils shall have corrosion protective coating.
 - 1. Provide condenser coil coating as specified in design documents.
- C. All coating materials and methods must pass a minimum of 10000 hours of salt spray exposure in a testing performed by an independent laboratory in accordance with ASTM B117.
 - 1. The company providing coating process shall also provide a five-year coil limited warranty.

2.5 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
 - 1. Equip with roller or ball bearings with grease fittings extended to outside of casing.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3-phase, with permanent lubricated ball bearings and built in thermal overload protection.
- C. High efficiency motors as indicated.

2.6 COMPRESSORS

- A. Construction: Hermetic, scroll and reciprocating type with heat-treated forged steel or cast iron shafts, aluminum alloy connecting rods, automotive type pistons, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil.
- B. Mounting:
 - 1. Statically and dynamically, balance rotating parts and mount on spring rubber-in-shear vibration isolators.
 - 2. Internally isolate hermetic units on springs.
- C. Lubrication System: Reversible, positive displacement oil pumps with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.
- D. Motor: Constant speed suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting, furnish with starter.
- E. Crankcase Heater:

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1. System evaporates refrigerant returning to crankcase during shut down.
2. Energize heater continuously even when compressor is not operating.

2.7 REFRIGERANT CIRCUIT

- A. Provide each unit with two speed compressors or dual refrigerant circuit, factory supplied and piped.
- B. If dual refrigerant circuits are used, circuit the AHU evaporator coil to provide individual circuits and expansion valves for each compressor, and individual piping runs installed.

2.8 CONTROLS

- A. On unit, mount weatherproof steel control panel, NEMA 250, containing power and control wiring, factory wired with single point power connection.
- B. For each compressor, provide across-the-line starter with dual pole contactor, minimum 3-minute (or manufacturer standard) anti-cycling time delay compressor overload relay, and control power transformer or terminal for controls power.
 1. Provide manual reset current overload protection.
 2. For each condenser fan, provide across-the-line starter with starter relay.
- C. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:
 1. High discharge pressure switch (manual reset) for each compressor.
 2. Low suction pressure switch (manual reset) for each compressor.
 3. Oil Pressure switch (manual reset).
- D. The installing contractor shall perform any control field wiring required.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install equipment in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service. (Refer to Division 26)
- C. Install units on concrete base as indicated.
- D. Provide connection to refrigeration piping system and evaporators.
 1. The Contractor shall provide and install the following for each refrigerant circuit:
 - a. Suction and liquid line filter dryer replaceable core type.
 - b. A liquid line sight-glass and moisture indicator.
 - c. Thermal expansion valve for maximum operating pressure.
 - d. Insulated suction line
 - e. Suction and liquid line service valves and gage ports.
 - f. Charging valves
 - g. Refrigerant and oil

3.2 CONTRACTOR'S FIELD SERVICES

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- A. Test refrigerant system for leaks including lines connecting the condensing unit with air handling unit.
- B. Prepare and start systems.
- C. Supply initial charge of refrigerant and oil for each refrigerant circuit.
 - 1. Replace losses of refrigerant and oil.
- D. Inspect and test for refrigerant leaks quarterly during first year of operation.
 - 1. Repair all leaks and replace losses of refrigerant and oil to meet manufacturer's specifications.

3.3 FUNCTIONAL PERFORMANCE TESTING

- A. System Functional Performance Testing is part of the Commissioning Process.
 - 1. The Contractor shall perform the Functional Performance Testing and the Commissioning Authority shall witness and document the test.
 - 2. Refer to Section 01 91 00, Commissioning, for functional performance tests and commissioning requirements.
- B. Systems Readiness Checklists shall be completed and submitted for each piece of equipment included in this section.
- C. Include the functional performance testing of Condensing Units as part of the Air-Cooled Split System Functional Performance testing.

3.4 DEMONSTRATION AND TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative.
- B. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
- C. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.
- D. Refer to Section 01 91 00, Commissioning, for further contractor training requirements.
- E. Provide demonstrations and training for all types of Air-Cooled Split Systems installed in this project.

END OF SECTION

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SECTION 23 64 12 – AIR COOLED WATER CHILLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Chiller package.
- B. Charge of refrigerant and oil.
- C. Controls and control connections.
- D. Chilled water connections.
- E. Starters.

1.2 REFERENCES

- A. ARI 590 - Positive Displacement Compressor Water - Chilling Packages.
- B. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. ASHRAE 90A - Energy Conservation in New Building Design.

1.3 QUALITY ASSURANCE

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

1.4 WARRANTY

- A. Provide 5 years parts and labor warranty on the compressor and 2 years refrigerant warranty. The warranty will start on owner acceptance of the equipment.

1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Carrier
- B. Trane

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- C. York/JCI
- D. Or approved equal

2.2 MANUFACTURED UNITS

- A. Provide factory assembled and tested outdoor air cooled liquid chillers consisting of compressors, condenser, evaporator, thermal expansion valve, refrigeration accessories, and control panel. Provide microprocessor based control system. Construction, testing, and ratings shall be in accordance with ARI 590.
- B. Conform to UL 465 code for construction of water chillers and provide UL label.
- C. Conform to ASME SEC 8 Boiler and Pressure Vessel Code for construction and testing of water chillers.
- D. Conform to ASHRAE 15 code for construction and operation of water chillers.
- E. Chillers shall have multiple scroll type compressors with independent refrigerant circuits.

2.3 HERMETIC COMPRESSORS

- A. Scroll Compressors:
 - 1. Unit: Direct drive, hermetic, scroll compressor with control panel.
 - 2. Features: Differential refrigerant pressure oil pump, oil level sight glass, oil heater, oil separator and filter, oil charging valve, flooded lubrication for the journal and thrust bearings, check valve on the scroll discharge port.
 - 3. Motor: Suction gas-cooled, hermetically sealed, squirrel cage induction.

2.4 EVAPORATOR

- A. Provide shell and tube type evaporator, seamless or welded steel or stainless steel construction with cast iron or fabricated steel heads, seamless copper tubes or red brass tubes with integral fins, rolled or silver brazed into tube sheets. Provide multiple refrigerant circuits on multiple compressor units.
- B. Design, test, and stamp refrigerant side for 225 psig working pressure and water side for 150 psig working pressure, in accordance with ASME SEC 8.
- C. Insulate with 1.5 inch minimum thick flexible polyurethane foam insulation with maximum K value of 0.28.
- D. Provide water drain connection and thermometer wells for temperature controller and low temperature cutout.

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2.5 CONDENSERS

- A. Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing or aluminum tubing. Provide sub-cooling circuits with liquid accumulators. Air test under water to 425 psig. Provide louvered panels to cover the complete condensing coil.
- B. Provide vertical discharge direct driven propeller type low sound condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing. Low sound fans shall be dynamically and statically balanced, corrosion resistant glass fiber reinforced composite blades molded into a low noise fan blade.
- C. Provide fan motors with permanently lubricated ball bearings.

2.6 ENCLOSURES

- A. House components in welded steel frame with or galvanized steel panels with weather resistant baked enamel finish capable of withstanding 500-hour salt spray test in accordance with the ASTM B-117 standard.
- B. Mount starters and disconnects in NEMA ICS 6 weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

2.7 REFRIGERANT CIRCUIT

- A. Provide HFC-R410A refrigerant or R-134a.
- B. Provide two separate refrigerant circuits, factory supplied and piped.
- C. Provide for each refrigerant circuit:
 - 1. Liquid line solenoid valve.
 - 2. Filter dryer (replaceable core type).
 - 3. Liquid line sight glass and moisture indicator.
 - 4. Thermal expansion valve sized for maximum operating pressure.
 - 5. Charging valve.
 - 6. Insulated suction line.

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7. Discharge line check valve.
8. Compressor discharge service valve.
9. Condenser pressure relief valve.
10. Suction line accumulator.

2.8 MISCELLANEOUS FEATURES

- A. Provide one compressor cycle counter and hour meter(s) for each circuit.
- B. Provide neoprene-in-shear isolators, suction and discharge pressure gauges and oil pressure gauge, flow switch for field installation.
- C. Unit shall have 2 separate single-pole, double-throw contacts to indicate compressor operation. Failure shall indicate manual reset required.
- D. Provide across-the-line starter, factory mounted and fully wired to the compressor and control panel. Starters shall be housed in a weather tight enclosure.
- E. Provide two-point lubrication for each bearing and connecting rod.
- F. Unit voltage shall be as shown on the schedule. Chiller shall require only one connection including unit power, control and heat trace power. All required transformers shall be provided.
- G. NEMA rated, weatherproof, heavy duty chiller disconnect switch will be supplied.
- H. Provide electric heat tracing to -20°F.
- I. Provide factory installed wire mesh guards for the compressors and louvers to protect the condenser section.
- J. Provide factory installed water inlet strainer.

2.9 CONTROLS

- A. Provide NEMA ICS 6 weatherproof steel control panel, containing starters power and control wiring, molded case disconnect switch, factory wired. Provide star delta closed transition starters. Provide disconnect for outdoor duty.
- B. Provide compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection.

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- C. Chiller control shall be standalone direct digital control (DDC) system which shall be capable of communications with the building automation system through a BACnet interface.
- D. Provide safety controls with display on control panel, arranged so any one will shut down chiller and require manual reset.
 - 1. Low chilled water temperature switch.
 - 2. High discharge pressure switch for each compressor.
 - 3. Low suction pressure switch for each compressor.
 - 4. Oil pressure switch for each circuit.
 - 5. Flow switch in chilled water line.
 - 6. Phase loss/reversal.
 - 7. Compressor overload.
 - 8. Loss of refrigerant charge.
 - 9. High motor winding temperature.
 - 10. Over and under voltage protection.
 - 11. Phase loss and phase reversal protection.
 - 12. Operating Controls:
 - a) For multi-compressor unit, provide modulating chilled water temperature controller, which matches chiller capacity to load.
 - b) Microprocessor shall be capable of communicating to building EMS.
 - c) Provide anti-recycle timer.
 - d) Leaving chilled water temperature control based on factory P.I. algorithms.
 - 13. Display suction and discharge refrigerant pressures, and oil pressures for each compressor, entering and leaving chilled water temperature, diagnostic checks at control panel.

PART 3 EXECUTION

3.1 INSTALLATION

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- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on concrete foundations.
- C. Connect to electrical service. Refer to Division 26.
- D. Connect to chilled water piping.
 - 1. On inlet, provide:
 - a) Thermometer well for temperature controller.
 - b) Thermometer well for temperature limit controller.
 - c) Flexible pipe connector.
 - d) Shut-off valve.
 - e) Strainer.
 - 2. On outlet, provide:
 - a) Flexible pipe connector.
 - b) Shut-off valve
 - c) See detail for all piping requirements
- E. Arrange piping for easy dismantling to permit tube cleaning.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Starting of System: Prepare and start system.
- B. Supply service of factory trained representative for a period of 1 day to supervise testing dehydration and charging of machine, start-up, and instruction on operation and maintenance to Owner.
- C. Supply initial charge of refrigerant and oil.

3.3 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate system operation and verify specified performance.

END OF SECTION

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SECTION 23 73 00 – MODULAR AIR HANDLING 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

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4. Date of manufacture

1.3 WARRANTY

- A. All equipment, materials, and workmanship shall be warranted for twelve (12) months from project acceptance.
 1. 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. Trane
- B. Carrier
- C. JCI/York
- D. Daikin
- E. Or approved equal

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

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- channel shall have a minimum height of 10 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 on plans. 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 double width double inlet (DWDI) housed fans as scheduled. Double width double inlet (DWDI) 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.

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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 (L10) 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. Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished. All drives shall be fixed pitch. All fans shall be equipped with multiple belt drives.
- 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 NEMA premium efficiency.
- B. The motor shall be mounted on the same isolation base as the fan. The motor shall be on an adjustable base.

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 16-gauge stainless steel construction (including stainless steel construction for intermediate troughs) 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.

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- 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. Coil casing to be constructed of 16-gauge and galvanized steel for heating coils and stainless steel for cooling coils. Intermediate casing supports shall be supplied for finned lengths that exceed 60 inches.
- G. 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.
- H. 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".
- I. 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.
- J. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

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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 and high efficiency rigid cartridge filters. Rigid filter media shall be 12" deep.
- C. Unit manufacturer shall provide three (3) sets of prefilter media, and three (3) sets of final filter media with the unit for installation by others.
- D. Filter access must be readily accessible and require no tools to change. Access doors shall be hinged with cam locks. Any questionable means of access shall be replaced at no additional cost to owner.

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.
- B. Damper on the return air duct connection of the mixing box shall be a rated smoke damper. Dampers shall meet the requirements of NFPA 80, 90A, 92A, 92B, and 101 and shall be Class I Leakage Rated Dampers for use in smoke control systems in accordance with the latest version of UL555S. As part of the UL qualification, smoke dampers shall have demonstrated a capacity to open and close under HVAC system operating conditions, with pressures up to 4 inches w.g. in the closed position and 2,000 fpm air velocity in the open position. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 250°F, depending upon the actuator. Appropriate electric actuators shall be installed by the damper manufacturer at the time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555S qualifications for both dampers and actuators. Each damper shall be rated for leakage and airflow in either direction through the damper. Damper and actuator assembly shall be factory cycled to ensure operation.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install each unit on a channel base with a height as scheduled, grouted to set level.

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- 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 frame 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. Install service valves and companion flanges or unions on supply and return lines to coils.
 - 4. 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. Install 65% final filters prior to energizing unit. 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.

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- 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 23 81 00 – PACKAGED HEAT PUMP UNITS

PART 1 GENERAL

1.1 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. ARI 360 - Unitary Air-Conditioning Equipment.
- C. ANSI/ASHRAE/IESNA 90.1 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

1.2 SUBMITTALS

- A. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.
- B. Submit product data indicating rated capacities, weights, accessories, service clearances and electrical requirements.
- C. Submit manufacturer's installation instructions.

1.3 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures.

1.4 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.5 WARRANTY

- A. Provide a full parts and labor warranty for one year from date of project acceptance.
- B. Provide five year extended warranty for compressors including materials and labor.

1.6 REGULATORY REQUIREMENTS

- A. Unit shall conform to UL 1995/CSA 22.2 #236 for construction of packaged air

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conditioner and shall have UL/CSA label affixed to the unit.

1.7 SUMMARY

- A. The contractor shall furnish and install packaged air conditioning unit(s) as shown and as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the conditions specified, scheduled or as shown on the contract drawings.

PART 2 PRODUCTS

2.1 GENERAL UNIT DESCRIPTION

- A. Unit(s) furnished and installed shall be a packaged unit as specified on the contract documents and within these specifications. Cooling capacity ratings shall be based upon ARI Standard 360. Unit(s) shall consist of insulated weathertight casing with compressors, air cooled condenser coil, condenser fans, evaporator coil, filters, supply fan motors and drives, and unit controls. Unit shall be specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
- B. Package units shall be constructed for installation on a concrete curb providing full perimeter support under air handler section and pedestal support under condenser section.
- C. Unit(s) shall be factory run tested to include the operation of all fans, compressors, heat exchangers, and control sequences.
- D. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

2.2 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating durable enough to withstand a minimum of 500 consecutive-hour salt spray application in accordance with standard ASTM B 117. Structural members shall be heavy gauge with access doors and removable panels of heavy gauge steel. Roof panels shall be sloped to provide positive drainage of rain water / melting snow away from the cabinet.
- B. Access Doors: Fully gasketed hinged doors with fluted knob fasteners and chained "tie-backs" to provide access to filters, heating section, return/exhaust air fan section, supply air fan section and evaporator coil section.
- C. Control Panel: The unit control panel section shall be compartmented to separate high and low voltage components. The control panels shall also be fully gasketed, hinged and provided with quick release latches for easy access.
- D. Insulation: Provide 1/2 inch thick coated fiberglass internal liner on all exterior panels in

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contact with the conditioned air stream.

2.3 AIR FILTERS

- A. Air Filters: Filters shall mount integral within unit casing and be accessible via hinged access panels. Filters shall be four inch MERV 8 rating. One set for each type of filter shall be furnished with air handler and contractor shall furnish an additional set after construction.

2.4 SUPPLY FANS

- A. Provide a backward-curved plenum fan with an external rotor direct drive variable speed motor with a potentiometer for variable speed adjustment located in the control box.
- B. Mount fan motor(s) and fan on a common base assembly and isolated from unit with double deflection rubber-in-shear isolators. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation.
- C. Fan shaft shall be mounted on grease lubricated ball bearings.
- D. Motor shall be open drip-proof. Motor shall have a standard T-frame and a minimum service factor of 1.15. All drive components shall be accessible without the use of scaffolds or ladders, to facilitate periodic maintenance checks and for operator safety.

2.5 EVAPORATOR COIL SECTION

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Evaporator coil shall be inter-circuited to maintain active coil face area at part load conditions. Coil shall also utilize internally enhanced tubing for maximum efficiency.
- B. Provide a thermostatic expansion valve (TXV) for each refrigerant circuit. Factory pressure and leak test coil at 300 psi.
- C. Provide pitched stainless steel drain pan to assure positive drainage of condensate from the unit casing.

2.6 CONDENSER SECTION

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes. Factory leak test coil under 450 psia pressure.
- B. Provide sub-cooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
- C. Provide vertical discharge, direct drive fans with steel blades, and three phase motors. Fans shall be statically and dynamically balanced. Motors shall be permanently

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- lubricated, with built-in current and thermal overload protection and weathertight slinger over motor bearings.
- D. Furnish unit with factory-installed electronic low ambient option to allow for operation down to 32 degrees F.
 - E. Provide factory-installed louvered steel coil guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components. Louvered panels shall be fabricated from heavy gauge galvanized steel and be rigid enough to provide permanent protection for shipping and pre-/post- installation. Course wire mesh is not an acceptable material for coil guards.
 - F. Condenser coils shall be wrap-around or V-banked. The coils shall not exceed 14 fins per inch density in order to permit routine cleaning, and prevent excessive air pressure drop across the condenser coil.

2.7 REFRIGERATION SYSTEM

- A. Compressor: shall be industrial grade, energy efficient direct drive 3600 RPM maximum speed scroll type. The motor shall of a suction gas cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve. Each compressor shall have a factory installed crank case heater.
- B. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge. Provide high and low pressure cutouts, and reset relay.
- C. Provide factory-installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.
- D. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage. Provide factory-installed hot gas bypass shall be required on all VAV units to prevent coil frosting.
- E. Refrigerant shall be R-410A.

2.8 OUTDOOR AIR SECTION

- A. Provide an air flow monitoring station to measure and control outside air quantities. The air flow monitoring station shall consist of multi-port sensing tubes across at least 75% of the area at the face of the intake hood or duct to ensure adequate and stable readings. The flow measurements shall be accurate to +/-5% from 100% down to 15% of nominal flow. It shall be also be capable of temperature and altitude compensation correcting for changes in air density.

2.9 DAMPERS

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- A. Provide low leak dampers with a leakage rate not to exceed 2.5% of nominal airflow at one inch W.C. static pressure.
- B. Leakage rate shall be determined in accordance with AMCA Standard 575.

2.10 DDC MICROPROCESSOR CONTROLS

- A. General - Each unit shall be provided with a factory-installed, programmed and run-tested, stand-alone, microprocessor control system. This system shall consist of temperature and pressure (thermistor and transducer) sensors, printed circuit boards, and a unit-mounted Human Interface Panel. The microprocessor shall be equipped with on-board diagnostics to indicate that all hardware, software, and all interconnected wiring and sensors are in proper operating condition. The microprocessor's memory shall be non-volatile EEPROM type, thus requiring no battery or capacitive backup to maintain all data during a power loss.
- B. The Human Interface Panel shall be readily accessible for service diagnosis and programming without having to open the main control panel on the rooftop unit. Alphanumeric coded displays shall not be acceptable.
 - 1. Human Interface (HI) Panel - shall be a 16 key touch-sensitive membrane key switch panel, password protected to prevent use by unauthorized personnel. The Human Interface Panel display shall consist of a 2 line by 40 characters per line clear English display. The display shall be Supertwist Liquid Crystal Display (LCD) with blue characters, 5 X 7 dot matrix with cursor, on a gray-green background for high visibility and reading ease.
- C. Anti-recycle Protection - shall be provided to prevent excessive cycling, and premature wear, of the compressors, contactors and related components.
- D. Each unit shall be provided with a BACnet interface card that will be connected to the Building Management System.

2.11 MISCELLANEOUS FEATURES

- A. Remote Set Point: Provide potentiometer for VAV/CV units to allow for remote setting of the discharge air set point based on the outside air temperature, zone average temperature or the position of the dampers in the building's terminal units. Input shall be received from the Building Automation System to reset the discharge air set point.
- B. Horizontal Discharge: Provide field removable access panels to allow for horizontal discharge and return applications.
- C. Provide unit mounted 115 volt convenience outlet

PART 3 EXECUTION

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3.1 EXAMINATION

- A. Verify that equipment pad or curb is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on equipment curb. Install unit level.
- C. If unit is operated during construction, provide minimum of MERV 8 filtration throughout construction up to final turn-over to the Owner. After the unit and system is turned over to the Owner, the contractor shall provide new filters in the unit.
- D. If unit is operated during construction, the contractor shall make every effort to keep the condenser coil clean from dirt and debris. Clean condenser coil per the manufacturer's recommendations after the system is turned over to the Owner.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall provide factory startup and 1st year labor warranty on the entire packaged system.
- B. In the Base Bid provide a minimum of 8 hours of training to the Owner on the operation and maintenance of all components (including controls) associated with the equipment. Training shall be divided into two 4-hour sessions. These hours of training shall be conducted by appropriately qualified personnel. Formal classroom training is required in conjunction with walk-around inspection of the equipment. Manual shall be provided to each participant prior to training. An attendance log shall be maintained for each session with a copy to the Designer and Owner's Representative. Training shall be furnished at the site.

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. 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, wiring inspections in accordance with NCGS 143-143.2, rough-in, above ceiling, and final inspections. All scheduling of electrical inspections with SCO electrical inspector shall be Monday through Friday unless specifically exempted and approved by SCO. 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

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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.

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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 that 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."

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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. 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.

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- 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 26 05 00

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SECTION 26 05 13 - MEDIUM VOLTAGE CABLE

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Contractor shall furnish and install 15,000 Volt medium voltage power distribution cable as indicated on drawings and as specified herein.
- B. A stranded 600 volt insulated copper grounded neutral conductor shall be installed with cables.
- C. Cable terminations for use with dead front equipment and splices.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cable shall be shielded, single conductor, rated 15,000 Volts, 220 mils thick, type EPR medium voltage power cable MV-105 by Prysmian, Kerite, Okonite, or Engineer approved equivalents. Cable thickness shall have 133% insulation. Any proposed equivalent shall require State Construction Office prior to bid opening.
 - 1. The physical properties and thickness of the insulation and sheath, as well as testing methods, shall comply with the requirements of ICEA and AEIC specifications, ICEA Standard S-93-639 (NEMA Publication No. WC74), AEIC CS-8, ASTM B-496, IEEE Standard 241, and UL-1072 (type MV-105).
 - 2. Conductors shall be soft drawn, Type MV-105, Class "B", concentric compact or compressed, stranded copper, single conductor shielded cable. The shielding process shall be one (1) of the following:
 - a) A true triple extrusion (done simultaneously, in a common extrusion head which does not expose the EPR insulation to the atmosphere). The cable shielding shall consist of, semiconducting strand shield, EPR insulation and semi-conducting insulation shield.
 - b) A true triple tandem extrusion process, where the semi-conducting strand shield, the insulation and the semi-conducting insulation shield are EPR.
 - c) Double extrusion process for the non-conducting cable shield and the insulation; the nonconducting cable shield shall be continuously tested for 2kV DC test while the shield is over the conductor and prior to the EPR insulation & the insulation shield being applied
 - 3. Cable shall be capable of operating at a normal continuous conductor temperature of 105°C, an emergency overload conductor temperature of 140°C, and a short circuit conductor temperature of 250°C.
 - 4. Cable shall be shielded with minimum 5 mil metallic uncoated copper tape applied helically with 25% nominal overlap.

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5. The overall jacket or sheath shall be oil, acid, alkali, and sunlight-resistant PVC compound which shall be rated for use in conduit or aerial construction. Cable identification shall be printed on this jacket using indelible ink. The cable identification shall indicate “the manufacturer, the plant number, cable size, year of manufacture, insulation thickness, insulation type, voltage rating, KV% insulation level& sequential footage number”.
 6. Cable shall pass the flame test in accordance with the IEEE 1202, CSA FT4 & ICEA T-29-520.
 7. The cable shall meet or exceed the following standards: ICEA S-93-639, NEMA WC 74, AEIC CS-8, ASTM B-496, UL-1072 (type MV-105) for all cables, IEEE 383 for cables 250KCM and larger.
 8. The Quality Assurance Program and the ISO certification shall be provided to State Construction Office upon request.
 9. Qualification Test Report for the cable insulation system (conductor-shield, insulation, and insulation-shield) shall be provided to State Construction Office upon request.
 10. The cable supplied shall have been manufactured within 12 months prior to date of order placement.
- B. Cable terminators with stress cones and splices shall be Raychem #HVT Series, #HVS-800 Series, and #HVSY-1520-SC Series (respectively), or equivalents by 3M, Cooper or Elastimold.
- C. Cable terminations for use with dead front equipment shall utilize industry standard molded rubber load-break elbows to match insert on device and electrical characteristics of electrical system components. 600 amp and 200 amp rated for required application.
- D. All splices shall be made with manufacturers standard molded rubber bolted “Tee” connectors as manufactured by 3M, Cooper or Elastimold.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The cable shall be installed in continuous lengths and fireproofed in each manhole as described below. Splices will be permitted only at manholes or junction boxes indicated on drawings and as approved by the Engineer and authorized representative of the Owner. All splices and terminators, including stress cones shall be fabricated in accordance with cable and terminator manufacturer's recommendations.
- B. Cable pulling tensions shall not exceed manufacturer's recommendations. Cable pulling tension and side wall pressure calculations shall be performed to assure that all circuits are installed in strict accordance with the physical limits of the cables as stated by the manufacturer. Contractor shall submit cable installation instructions that shall include tension limitation, bending radius, etc. Contractor shall maintain a log of pulling tensions as cable is installed.
- C. Provide cable racks in manholes as required by the NEC and specified herein and on drawings.

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- D. Cable shall be fireproofed at each manhole.
1. The fireproofing tape shall consist of a flexible conformable fabric having one (1) side coated with a flame-retardant, flexible polymeric coating and/or a chlorinated elastomer.
 2. The tape shall be 1/16 inch thick by 3 inches wide, wrapped around each conductor spirally with the coated side toward the conductor.
 3. The tape shall extend for the total length of the conductor in the manhole and 1 inch into the ducts.
 4. The tape shall be non-corrosive to the cable jacket, self-extinguishing, and shall not support combustion.
- E. Splices are to be permitted only in manholes as designated on the plans. All splices and terminations, unless otherwise specified, are to be fabricated in accordance with the cable and termination manufacturer's recommendations, or in accordance with the details of such instructions included on the drawings.
- F. Provide feeder identification markers on all cables as specified herein.

3.2 TESTING

- A. Each shipping length of cable shall be tested by the manufacturer at the factory and a certified test report submitted for approval by the Engineer prior to the cable being installed. The Contractor shall only perform a "Very Low Frequency with dissipation factor, Tangent Delta" (VLF tan delta) withstand test on the cable after it is installed, prior to energizing. The Contractor shall not repeat factory tests prior to installation.
- B. The factory test report shall include a high voltage A.C. test, insulation resistance measurements, corona test, leakage current curves for each minute up to 10 minutes at test voltage, and a reel I.D. tag. I.D. tag shall include the following information: customer job name, date manufactured, date of testing, type of cable voltage, length of cable, and life of warranty. These tests shall be performed on customer shipping lengths, not on factory master lengths.
- C. After installation, but prior to energization, the Contractor shall conduct a VLF tan delta withstand test of the system in accordance with IEEE 400 and the Design Engineer's specified testing procedure, as witnessed and "signed-off" by the Design Engineer. See ANSI/NETA Maintenance Testing Specifications. Copies of this test report shall be sent to the Owner, to the Engineer, and available at Beneficial or Final inspection by State Construction Office. Include the test report in the Operations and Maintenance Manual for Owner's future reference. Contractor shall notify Engineer at least one (1) week prior to test so that Engineer can make arrangements to be present at test if he deems it necessary. Test report shall identify each cable tested.

3.3 MEDIUM VOLTAGE CABLE WARRANTY

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- A. The cable manufacturer shall warrant to the Owner that each reel of cable is free from defects in material, design and workmanship and will provide reliable performance for a twenty-five (25) year life from the date of project final acceptance.
- B. The warranty assumes the cable is installed, spliced, terminated and maintained in accordance with manufacturer's recommendations.
- C. Prior to cable termination or splicing, Contractor shall submit the qualifications of personnel directly responsible for completing this work to the Engineer. Upon approval by the Engineer in writing, Contractor may proceed with this portion of the work.
- D. Defective cable shall be replaced at no cost to the owner.
 - a. When the manufacturer and the Owner mutually determine a portion of or all of the cable is defective, the cable manufacturer shall furnish replacement of said cable without charge.
 - b. The replacement cable shall comply with these requirements and be delivered to the original delivery point free of any charge to the owner or the State of North Carolina.
- E. Cable shop drawings shall include said described warranty from the cable manufacturer properly signed and having the manufacturer's corporate seal affixed thereto.

3.4 MEDIUM VOLTAGE CABLE INSTALLATION CERTIFICATION

- A. All terminations of cable shall be performed by a qualified, factory trained and certified technician with at least five (5) years experience in cable terminations.
- B. Provide a contractor certification with material submittals to the Engineer for approval prior to any termination work on this project.

3.5 REEL HANDLING AND STORAGE:

- A. The manufacturer shall ship all reels in an upright position on the flanges. The cable ends shall be sealed to prevent the entrance of moisture, gases or vapors into the cable.
- B. After the cutting of any length, the exposed ends of any remaining cable on the reel shall have heat-shrinkable end caps applied to prevent the entrance of water or vapor.
- C. The manufacturer shall be responsible to indicate to any commercial carrier the requirements for shipping the reels of completed cable. The Contractor shall be responsible for the acceptance inspection of the shipped cable reels and shall note any visible damage on arrival in any unacceptable orientation or condition and inform the carrier, distributor and manufacturer of such damage or unacceptable condition.
- D. Any movement or lifting of completed reels of cable shall be by the use of a bar inserted through the arbor hole in the cable reel and, as appropriate or necessary, use of a spreader bar to avoid damage to the reel flanges. No completed reel of cable shall be lifted by any force on or connection directly to the

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reel drum.

- E. Completed reels of cable shall be covered with a suitable material to reduce the impact of weather, rain or sunlight on the cable. Reels under the covering should have adequate ventilation to prevent the formation of condensation.

3.6 CABLE IDENTIFICATION:

- A. Each reel shall have an identification tag by the manufacturer securely attached to each flange and shall contain the following information, manufacturer's name & location, cable trade name, conductors size and voltage rating, identification of voltage rating, identification of insulation and jacket material, footage, and UL label.

END OF SECTION 26 05 13

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SECTION 26 05 19 – LOW-VOLTAGE 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.
- 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 shown otherwise on the drawings.
- G. Branch circuits shall be a minimum of #12, with 600-volt THHN/THWN insulation unless 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 degree Celsius 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 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

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grounding conductors shall be increased in size proportionately according to the circular mil area of the ungrounded conductor.

- K. Conductors for VFDs shall meet the following requirements: three-phase, three-ground, copper tape spiral shield, galvanized steel interlocked armor cable. Cable shall be Okonite's Type C-L-X or approved equivalent by General Cable or Belden.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All wiring shall be color coded as follows:
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. On 120/240 – volt, 3 phase, 4 wire/high leg delta systems – phase A, black; phase B, orange; phase C, blue; neutral, white.
 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. Switch legs, 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

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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 26 05 19

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SECTION 26 05 23 – CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 REQUIREMENTS

- A. Shall conform with Article 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 26 05 33.
 2. Conductors shall be #14 AWG minimum, stranded copper, and insulated with type THHN thermoplastic insulation rated for 600 volts.
 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 26 05 19.

PART 3 EXECUTION

THIS SECTION NOT USED

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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, indenter, 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

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ring, with a bolt or grounding clip. Jumper shall be sized by NEC with #12 minimum.

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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. 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.

- B. 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.

- C. 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.

- D. Rigid Nonmetallic Conduit:

1. Heavy wall rigid, type 40, listed for underground encased and above ground applications.

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2. Heavy wall rigid, type 80, listed for underground encased and above ground applications.

E. 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

F. Flexible Metal Conduit (FMC):

1. Electro-galvanized single strip steel.

G. Liquid Tight Flexible Metal Conduit:

1. Electro-galvanized single strip steel with PVC coating.

H. Stainless Steel Conduit:

1. Type 304 or 316

I. Standard and special radius elbows

1. 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.

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- 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 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 ¼" from wall with clamp-backs or strut.

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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.
 - 3. Outdoor Applications
- 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.
- C. Nonmetallic Rigid Conduit required:
 - 1. Direct burial, concrete encased.
 - 2. Direct burial, in sand fill on bottom and top.
 - 3. Corrosive atmospheres, except where specifically noted otherwise.
- 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 as noted on plans.
 - 2. In exterior environments needing additional protection.
- G. Stainless Steel Conduit shall be used for:
 - 1. Exposed conduits in GMP Clean Room or Wash Down environments.

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.

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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 identification of equipment controlled or served, phase, voltage, etc.
- 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.
- C. The smoke control system (including power, control and detection) shall be clearly marked at all junctions, accesses and terminations. Furnish and install permanently mounted label indicating smoke control system. Labels shall be made using electronic labeling system with red letters on white background (colors shall be confirmed with Owner during submittal process). 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. Blue surface with white core for high leg delta 120/240-volt equipment.
 - 4. Bright red surface with white core for all equipment related to fire alarm system.
 - 5. Brown surface with white core for all equipment related to data systems.
 - 6. 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

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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 26 05 53

SECTION 26 05 73 – SHORT-CIRCUIT/COORDINATION STUDY

PART 1 GENERAL

1.1 SCOPE

- A. The contractor shall furnish a short circuit coordination study which shall permit evaluation of harmonics as required by IEEE 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.2 RELATED SECTIONS

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - 4. IEEE 241 – Recommended Practice For Electric Power Systems in Commercial Buildings.
 - 5. IEEE 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid Immersed Distribution, Power and Regulating Transformers.
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
 - 5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage and for Simplified Calculation of Fault Currents.

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- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 – National Electrical Code, latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace
 - 3. Submittals for review/approval
- D. The short circuit study shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.4 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit study shall be summarized in a final report to be provided to the design engineer, electrical contractor, and mechanical contractor with the transformer, panelboard, enclosed circuit breakers, fusible switches and generator submittals so the evaluation of harmonics can be executed. The submittals shall be in the format as directed by the Architect or Owner or submit five (5) bound copies of the complete final report and two CD's in PDF format if not otherwise directed.
- B. The report shall include the following sections:
 - 1. One-line diagram showing protective device ampere ratings and associated designations, cable size and lengths, transformer kVA, transformer impedance, utility available short circuit current, and configuration of the electrical system inclusive of service and feeder conductor sizes and lengths and voltage ratings, motor and generator kVA ratings, and switchgear/switchboard/panelboard designations.
 - 2. Descriptions, purpose, basis and scope of the study.
 - 3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 - 4. Fault study input data, case descriptions and current calculations including a definition of terms and guide for interpretation of the computer printout.
 - 5. Comments and recommendations for system improvements where needed.
 - 6. Executive Summary including source of information and assumptions made.

1.5 QUALIFICATIONS

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- A. The short circuit study shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer in the state of North Carolina skilled in performing and interpreting the power system studies.

PART 2 PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
 - 1. EDSA Micro Corporation.
 - 2. ESA Inc.
 - 3. SKM Systems Analysis, Inc.

2.2 STUDIES

- A. Contractor to furnish short-circuit study. The short circuit study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and include the largest feeder circuit breaker and motor starter in the 480 Volt motor control centers and power distribution panelboards. The study shall also include variable frequency drives, transformers and protective devices associated with, emergency and standby generators, and distribution switchgear.

2.3 DATA COLLECTION

- A. Contractor shall furnish all field data as required by the short circuit study. The Engineer performing the short-circuit study shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future utility supplies, motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner and/or Contractor.
- D. Include fault contribution of all motors in the study, with motors <50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.4 SHORT-CIRCUIT STUDY

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- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- B. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
 - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 5. Typical calculations
 - 6. Tabulations of calculated quantities.
 - 7. Results, conclusion and recommendations.
- D. Calculate short circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - 1. Electric utility's supply termination point.
 - 2. Incoming switchgear
 - 3. Unit substation primary and secondary terminals
 - 4. Low voltage switchgear
 - 5. Motor control centers
 - 6. Standby Generators and automatic transfer switches
 - 7. Branch circuit panelboards
 - 8. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line to ground fault current study for areas as defined for the three-phase bolted fault short circuit study.

2.5 REPORT SECTIONS

- A. Input Data:
 - 1. Utility three-phase and line to ground available contribution with associated X/R ratios.
 - 2. Short-circuit reactance of rotating machines with associated X/R ratios

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3. Cable type, construction, size, number of phase, length, impedance and conduit type.
4. Bus duct type, size, length and impedance.
5. Transformer primary and secondary voltages, winding configurations, kVA rating, impedance and X/R ratio
6. Reactor inductance and continuous ampere rating
7. Aerial line type, construction, conductor spacing, size, number per phase, and length.

B. Short Circuit Data:

1. Source fault impedance and generator contributions
2. X to R ratios
3. Asymmetry factors
4. Motor contributions
5. Short circuit kVA
6. Symmetrical and asymmetrical fault currents.

PART 3 EXECUTION

3.1 FIELD ADJUSTMENT

- A. Make minor modifications to equipment as required to accomplish conformance with short circuit study and Harmonic study to determine required filtering per IEEE 519.
- B. Notify Owner in writing of any required major equipment modifications.
- C. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2 Year Warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

END OF SECTION 06 05 73

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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.

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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.

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3.2 PREPERATION

- 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 no 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 firestoppihg 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 26 05 93

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SECTION 26 12 19 – PAD-MOUNTED LIQUID-FILLED, MEDIUM VOLTAGE TRANSFORMER

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Electrical Contractor shall furnish and install a new complete and satisfactorily operating liquid filled pad mounted, dead front transformer as specified herein and as indicated on the drawings. All items of equipment, hardware, raceway, wiring, etc., required for a complete installation shall be furnished and installed whether or not every such item is specifically mentioned.
- B. Transformer construction and installation shall comply with the latest applicable standards of NEMA and ANSI including but not limited to the following:
 - 1. C57.12.00 Standard General Requirements for Liquid Immersed Distribution, Power, and Regulating Transformers.
 - 2. C57.12.10 Standard Requirement for Liquid Immersed Transformers,
 - 3. C57.12.28 Switchgear and Transformers, Pad-Mounted Equipment—Enclosure Integrity:
 - 4. C57.12.70 Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers; and
- C. Transformer tests shall be performed in accordance with C57.12.90 Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- D. Transformers shall be NCBCC approved third-party listed. Comply with NCGS 133-3 when using brand name specifications.
- E. Each transformer shall be rated for five (5) feet minimum clearance to building and other equipment, and a minimum or ten (10) feet on side with doors for “hot-stick” access. Provide FM labeled transformer for mounting close to buildings and equipment.

PART 2 MATERIALS

2.1 PAD MOUNTED TRANSFORMER

- A. Pad mounted transformer shall be manufactured by Eaton-Cooper, Square D, ABB, .
- B. Transformer shall consist of a primary connection and protector cubicle, a liquid-filled transformer section, and a secondary connection cubicle - all enclosed in hinged, totally enclosed weatherproof construction. Liquid shall be “R-Temp” or any “LISTED less-flammable liquid” equivalent to Bio-Temp or FR3 as required by NEC 450-23. The manufacturer is responsible for maintaining adequate documentation of the oil furnished in each unit and must provide copies upon request. Silicon is not acceptable. The unit shall be

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tamper proof and suitable for padlocking. The doors shall be so arranged that access to the high-voltage compartment can be gained only after opening the low-voltage compartment. Cables shall enter and leave the compartment sections through openings in the bottom and the concrete pad.

- C. The transformer tank, high voltage compartment and low voltage compartment shall be constructed as an integral unit that will limit disassembly, breakage and prying open of any of the doors, panels and sills with the doors in the closed and locked position. There shall be no exposed screws, bolts or other fastening devices which are externally removable. There shall be no openings through which foreign objects such as sticks, rods or wires might be inserted to contact live parts. Lifting eyes and jacking pads shall be provided as part of the transformer and shall be arranged to provide a distributed balanced fit.
- D. Construction shall conform to ANSI/IEEE Standard 386. Bushings shall be externally clamped and externally removable. High and low voltage winding lead lengths shall be long enough to permit field replacement of bushings or bushing wells. All gasketed joints are to afford a sealed tank in accordance with industry standards. Gasket materials must be durable and reusable. Parking stands shall be provided for mounting accessory equipment.
- E. Tank shall be sealed construction per ANSI Standard C57.12.26. The tank shall be a minimum of 12 gauge sheet steel and strong enough to with standard a pressure of 7 psi without permanent distortion and 15 psi without rupturing or displacing of transformer components.
- F. The high and low voltage compartments shall be located side by side, separated by a steel barrier. When facing the transformer, the low voltage compartments shall be on the right. Terminal compartments shall be full height, air-filled with individual doors. The high voltage door fastening shall not be accessible until the low voltage door has been opened.
- G. The core and coil assembly shall be of a five-legged wound core type design to provide adequate short-circuit strength and heat dissipation. Transformers connected wye-wye shall be built with five-legged core-type design to avoid the tank heating problems sometimes associated with wye-wye connections. When required, corrugated cooling panels shall be provided on the back and sides of the oil-filled tank to maintain a safe operating temperature. Internal leads shall be insulated, trained, and anchored to prevent phase-to-phase flashover.

2.2 PRIMARY CUBICLE

- A. The primary cubicle shall contain the following:
 - 1. High-voltage bushings shall be universal well type, dead front, arranged to receive incoming 15 kV cables utilizing loadbreak elbows. Provide one bushing well and one loadbreak feed-thru insert per phase. Bushings shall be externally clamped and externally removable. High and low voltage winding lead lengths shall be long enough to permit field replacements of bushings or bushing wells. All gasketed joints are to

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afford a sealed tank in accordance with industry standards. Gasket material must be durable and reusable. Parking stands shall be provided for mounting accessory equipment. Primary cubicle shall be completely dead front construction, inclusive of switching, fusing, and lighting arrestors.

2. An externally operable no-load tap changer.
3. A liquid-filling connection.
4. Tank grounding provisions (primary and secondary cubicles). Bond primary and secondary neutrals internally to transformer ground and driven rod. The grounding provisions shall be capped before painting the unit.
5. Lightning arrestors (distribution type), dead front construction shall be similar and equal to RTE "M.O.V.E." type, shall be mounted to the insert and shall be rated for 12,470 volts.
6. Provide a type oil-immersed current limiting fuses in series with bayonet liquid-immersed, overload sensing, expulsion fuses coordinated to provide full range protection with the expulsion fuse clearing low current faults and the current limiting fuses clearing high current faults up to 50kA. The fuse assembly shall have an interrupting rating of (3500A at 8.3kV single phase) or (1800 A at 15.5 kV), and a loadbreak rating of 125A at 80% power factor at (8.3kV or 15.5 kV) single-phase. The bayonet fuses shall be accessible through the primary compartment. Provide welded oil drip-shield under each fuse. Bayonet fuses shall be externally removable and field replaceable using hot-stick. This operation shall be accomplished without having to remove the transformer compartment top.
7. Fuses in the transformer shall be coordinated with the fuses in the 15kV sectionalizing switch. The electrical contractor shall provide new fusing for the sectionalizing switch.
8. Electrical contractor shall provide spare set of fuses for transformer.
9. Suitable barriers between phase connections.
10. For Wye-Wye Connected Transformers, the high voltage neutral shall be connected internally to the low voltage neutral with provisions for opening this connection for testing. The neutral bushing shall be fully insulated but connected to an adjacent ground pad (on the tank) with a detachable strap sized to carry the maximum fault current available from the transformer.

2.3 TRANSFORMER SECTION

- A. The transformer section shall be rated for kVA specified on drawings, oil-filled, self-cooled, 65°C rise with 5.75% impedance and manufacturer's standard BIL values. Primary voltage

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shall be 12,470/7,200 volts three phase, 60 Hertz, 4-wire WYE, grounded with four 2 1/2% taps with two above and two below rated voltage with factory connections to tap changer in the primary cubicle. Secondary voltage shall be 277/480 volts three phase, 4-wire WYE. Transformer shall be connected grounded-WYE to grounded-WYE. Other features of the transformer shall include:

1. A ground pad.
2. A name plate.
3. Provisions for lifting, pulling, and jacking.
4. One-inch drain, filler and sampling valves.
5. Filling and top filter press connection drain.
6. Bottom filter press (to completely drain).
7. A dial type thermometer.
8. A magnetic liquid level gauge.
9. A pressure-vacuum gauge.
10. A bolted and gasketed tank hand hole.
11. Fuses must be externally removable and field replaceable using a hotstick without having to remove transformer compartment top.
12. Terminal compartment shall be full-height, air-filled with individual doors. The doors shall be constructed with sheet steel (minimum 13 gauge) and braced to prevent distortion. They shall be installed using lift-off type stainless steel hinges of a gauge equal to, or greater than the door. A three-point latching mechanism with a cabinet-type handle, having provisions for the use of a single padlock, shall be provided on the low voltage door. A 1/2 inch penta-head stainless steel spring loaded captive bolt shall also be provided with a blind bolt hole. Removal of the penta-head locking bolt may only be accomplished after removal of the padlock. This latching mechanism shall be designed and located to provide access to the high voltage compartment only after the door to the low voltage compartment has been opened. There shall be one more additional fastening device that must be removed before the high voltage door can be opened. Door stops shall be provided to hold the doors open when working in the compartments. The doors and the front sill of the compartments shall be removable to allow sliding the transformer into position over conduit stubs. The high and low voltage compartments shall be separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right.

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13. Provisions for opening the connection between high and low voltage neutral and for a fully insulated neutral bushing, connected to the ground pad with a detachable strap sized to carry maximum available fault current.
14. The core and coil assembly shall be of a five-legged design to provide adequate short circuit strength and heat dissipation.
15. Internal leads shall be insulated, trained and anchored to prevent phase to phase flash over.
16. Pressure-relief device that shall automatically relieve pressure and effectively keep the transformer sealed with no leakage of air or oil or any permanent distortion. The pressure-relief device shall exclude moisture from the transformer and have a life equal to the transformer.
17. The transformer shall be provided with a NEMA standard outside warning label on the outside high voltage compartment, and a NEMA standard inside "DANGER" label on the inside low voltage compartment door.
18. The transformer shall be identified as a non-PCB oil cooled unit with the PCB content clearly and permanently marked on the nameplate.
19. The low voltage bushing shall be molded epoxy and capable of withstanding a load in the vertical direction of 800 inch-lbs. without causing a deflection sufficient to produce a leak.
20. In preparation for painting the transformer, the metal shall be washed with a solvent to remove rust, oil and grease. A minimum primer coat of 2 mils dry finish shall be applied. The finish coat of paint, with a minimum of 2-1/2 mils dry finish shall be olive green munsel 7GY3.29/1.5, gray or equivalent.

2.4 SECONDARY CUBICLE

A. The secondary cubicle shall have the following:

1. The low voltage bushing shall be molded epoxy and capable of withstanding a load in a vertical direction of 800-inch-lbs with out causing a deflection sufficient to produce a leak. The bushings shall be externally clamped, blade type spade terminals with four (4) – hole NEMA standard spacing for transformers up to 500 kVA. Transformers above 500 kVA shall be equipped with six (6) – hole NEMA spacing. The bushing shall be arranged for vertical take-off.
2. A permanently affixed stainless steel name plate containing the transformer serial number, style number, plus other pertinent information.

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PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall meet seismic requirements of Section 26 05 29 of these specifications.
- B. Provide “DANGER HIGH VOLTAGE – KEEP OUT” on the outside of the transformer.

END OF SECTION 26 12 19

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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. Square D panelboards are specified as a basis for design. Equivalents by Cutler-Hammer or General Electric Co. 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 26 05 00.

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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.
- 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.
- 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

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NFPA 70E requirements and shall provide labels for each panel with the available fault current and the date the calculation was performed shall be field marked on the enclosure at the point of supply. The marking shall comply with 110.21(B)(3).

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 26 05 53.
- 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". Refer to Specification Section 26 05 53 for additional details.

END OF SECTION 26 24 16

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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).
- C. Individual neutral wires shall be provided for each circuit (no sharing of neutrals between circuits) or multi-wire branch circuits shall be provided with a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuit originates.
- 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:

Hubbell 1221
P & S 20AC1
Leviton 1221

B. Duplex receptacles considered equivalent are as follows:

1. Heavy Duty Specification Grade:

Hubbell 5362
P & S 5362
Leviton 5362

C. The color of all devices shall be verified with Engineer. 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 extra duty rated weather proof while-in-use protective covers.

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 26 27 26

SECTION 26 29 00 – LOW-VOLTAGE CONTROLLERS

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 such that the 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.

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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 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.

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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 Section 26 05 53 for additional information.
 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 26 29 00

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SCO ID#: 22-24913-02A, Code 42107, Item 4112**

DIVISION 28 – FIRE ALARM SPECIFICATIONS
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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 NCDOI website), 2018 NC Fire Prevention Code, 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

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- A. The existing FACUs in the project are Notifier AFP-5000 in the Gym/Auditorium, Phoenix, and Sparrow Dorms, and Simplex 4010ES in Single Cell B and Falcon dorm or similar series by same manufacturer (Contractor shall field verify). 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. 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.) 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. Pull Stations: Existing to remain.
 7. 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. Provide weatherproof were required.
 8. 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

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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. Provide weatherproof where required.

9. 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 as indicated in the contract documents 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.
10. 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.
11. Unless the AHJ requires otherwise, all duct detectors and duct smoke arrays shall be programmed for supervisory.
12. 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.
13. 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

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above lay-in ceiling), and shown on the as-built drawings. Devices shall have visible LED(s) on cover.

14. 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.
15. 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.

16. 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)).

17. 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.

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18. 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.

- C. 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.

- D. Contractor shall label all wires terminating in junction boxes and riser boxes. These labels shall be self-adhesive wire numbers.

- E. 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.

- F. 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.

- G. The contractor shall provide any special equipment, tools, and programming devices required for the operation, maintenance or repair of the installed fire alarm system.

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2.2 FUNCTION

- A. Activation of the duct smoke detectors 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. Actuate General Evacuation signal
 6. Display change of status
 7. Transmit "Fire Alarm" signal to Central Station.
 8. Release Magnetically Held Smoke Doors
 9. Release smoke dampers
 10. Unlock exit doors
 11. Shutdown AHUs
 12. Activate Smoke Purge Mode
- B. The fire alarm system shall be programmed to activate the smoke purge by the fire alarm purge relay when the return air duct detector is activated. The AHU shut down shall also be activated by the fire alarm shut down relay when the supply air duct detector is activated. 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. 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

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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.

- E. 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.
- F. 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.
- G. 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, 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

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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.

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- 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) 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. Where required for compliance with the provisions of this code, devices, equipment, systems, conditions, arrangements, levels of protection or other feature shall there after be continuously maintained in accordance with applicable NFPA requirements or as directed by the fire code official.
- T. Testing of smoke sensing devices shall be accomplished using manufacturer and NFPA approved methods for all devices.
- U. Smoke detector sensitivity shall be checked within one year after installation and every alternate year thereafter. After the second calibration test, where sensitivity tests indicate that the detector has remained within its listed and marked sensitivity range, the length of time between calibration tests shall be permitted to be extended to not more than 5 years. Where frequency is extended, records of detector-caused nuisance alarms and subsequent

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trends of these alarms shall be maintained. In zones or areas where nuisance alarms show any increase over the previous year, calibration tests shall be performed.

1. To verify that each smoke detector is within its listed and marked sensitivity range, it shall be tested using one of the following methods:
 - a) A calibrated test method
 - b) The manufacturer's calibrated sensitivity test instrument
 - c) Listed control equipment arranged for the purpose
 - d) A smoke detector / control unit arrangement whereby the detector causes a signal at the control unit where the detector's sensitivity is outside its acceptable sensitivity range.
 - e) Another calibrated sensitivity test method acceptable to the fire code official
 2. Smoke detector sensitivity shall not be tested or measured using a device that administers an unmeasured concentration of smoke or other aerosol into the detector.
- V. 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.
 7. Alterations to existing fire alarm systems shall be recorded on the original documents inclusive of the record of completion form.
- W. 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

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report and sensitivity test report; how to synchronize stobes 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.

1. On-site training shall also include:
 - a) variable changes
 - b) programming changes
 - c) report creations and changes
 - d) system functional changes
 - e) hardware repair and maintenance of all building panels and devices, including but not limited to, diagnostic procedures, system expansion, and maintenance techniques.

- X. Contractor shall provide the training, technical manuals, spare parts, and system documentation prior to system acceptance testing by Engineer, Owner and AHJ.

- Y. 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.

- Z. 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).

- AA. 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.

- BB. The building owner shall be responsible to maintain the fire and life safety systems in an operable condition at all times. Service personnel shall meet the qualification requirements of NFPA 72 for inspection, testing and maintenance of such systems. Records of inspection, testing and maintenance shall be maintained.

3.2 SUBMITTALS

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- 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.
- D. 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.
- E. 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.
- F. 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.
- G. 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.

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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.
- H. 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.
- I. 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.
- J. 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.
- K. Provide an engraved label meeting per Section 26 05 53 of these specifications on the at each system sub-panel or data gathering panel, smoke purge relay box, 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.

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APPENDIX A – FIRE ALARM TESTING CHECKLIST

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END OF SECTION 283100

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:
 - cut sheets
 - battery size calcs
 - Matrix
 - plans
 - Voltage drop calcs
 - 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 programmed 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
 - o Branch circuit to FACU does not share conduit with 24vdc alarm initiating circuits or notification appliance circuits.
 - o 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)
 - o 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)
 - o 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 ____/____
 - Ionization smoke ____/____
 - Pull Station ____/____
 - Duct smoke ____/____
 - Other detector ____/____
 - tamper switch ____/____
 - Heat detector ____/____
 - Flow 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 at least one 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

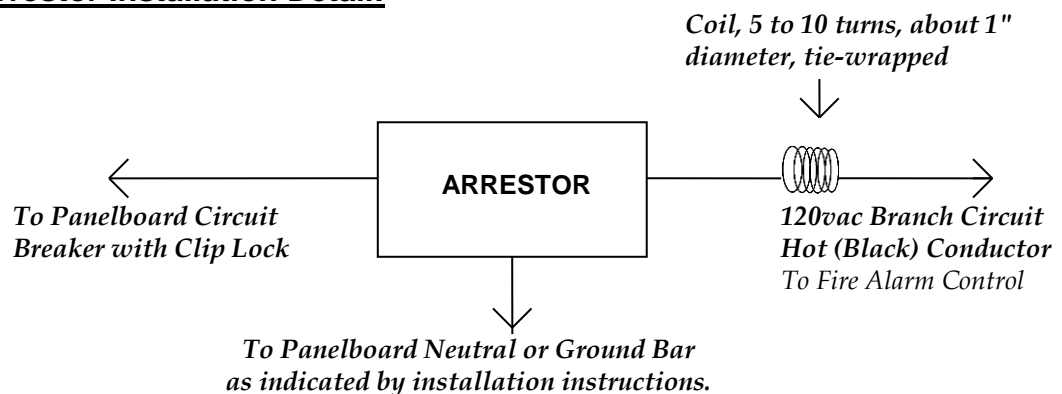
NFPA 72 Chapters (note they vary by version year)

(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

Air Conditioning Installation

Contract: C11549

North Carolina Correctional Institution for Women

Bidder: _____

SCO ID 22-24913-02A

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 the Department of Adult Correction

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 adding air conditioning to three existing 208-Bed Dormitories at the NC Correctional Institution for Women in full in complete accordance with the plans, specifications, and contract documents, to the full and entire satisfaction of the State of North Carolina, and the

Department of Adult Correction and McKim & Creed

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:

Plumbing Subcontractor:

_____ Lic _____

_____ Lic _____

Mechanical Subcontractor:

Electrical Subcontractor:

_____ Lic _____

_____ 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. (Strike out "Add" or "Deduct" as appropriate.)

GENERAL CONTRACT:

Alternate No. 1: Provide all work indicated in Single Cell B

(Add) _____ Dollars(\$)

Alternate No. 2: Provide all work indicated in Auditorium/Gymnasium

(Add) _____ Dollars(\$)

Alternate No. 3: Owner Preferred Brand for HVAC Controls – Distech ECB Series

(Add) _____ Dollars(\$)

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work 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

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.

and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

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)

*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.

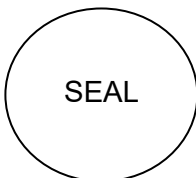
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure 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

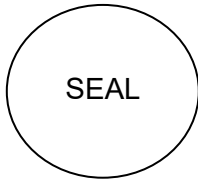
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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.**

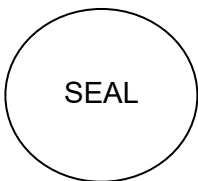
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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 Name)
Project ID# _____ 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:

- A. 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.
- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. 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.
- E. Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- F. Copy of pre-bid roster
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- H. Letter detailing reasons for rejection of minority business due to lack of qualification.
- I. 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.

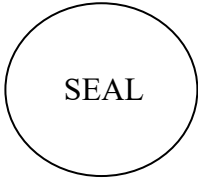
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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 _____

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

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

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:

Base Bid:	\$X,XXX,XXX.XX
Alternate #1 – XXXX	\$X,XXX,XXX.XX
Total:	\$X,XXX,XXX.XX

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. In the event performance and payment bonds are required as a condition of this contract, 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 two (2) counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

(Proprietorship or Partnership)

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Date: _____

Attest: (Corporation)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

The State of North Carolina through

(CORPORATE SEAL)

North Carolina Department of Adult Correction
Central Engineering

Witness:

By: _____

Jeffrey O'Briant, PE, PLS

Title: Director of Engineering

Date: _____

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:

Contractor: (Trade or Corporate Name)

(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

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice
Pres. only)

(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

APPENDIX A

BMS GRAPHICS STANDARDS

Page 1: Main Page

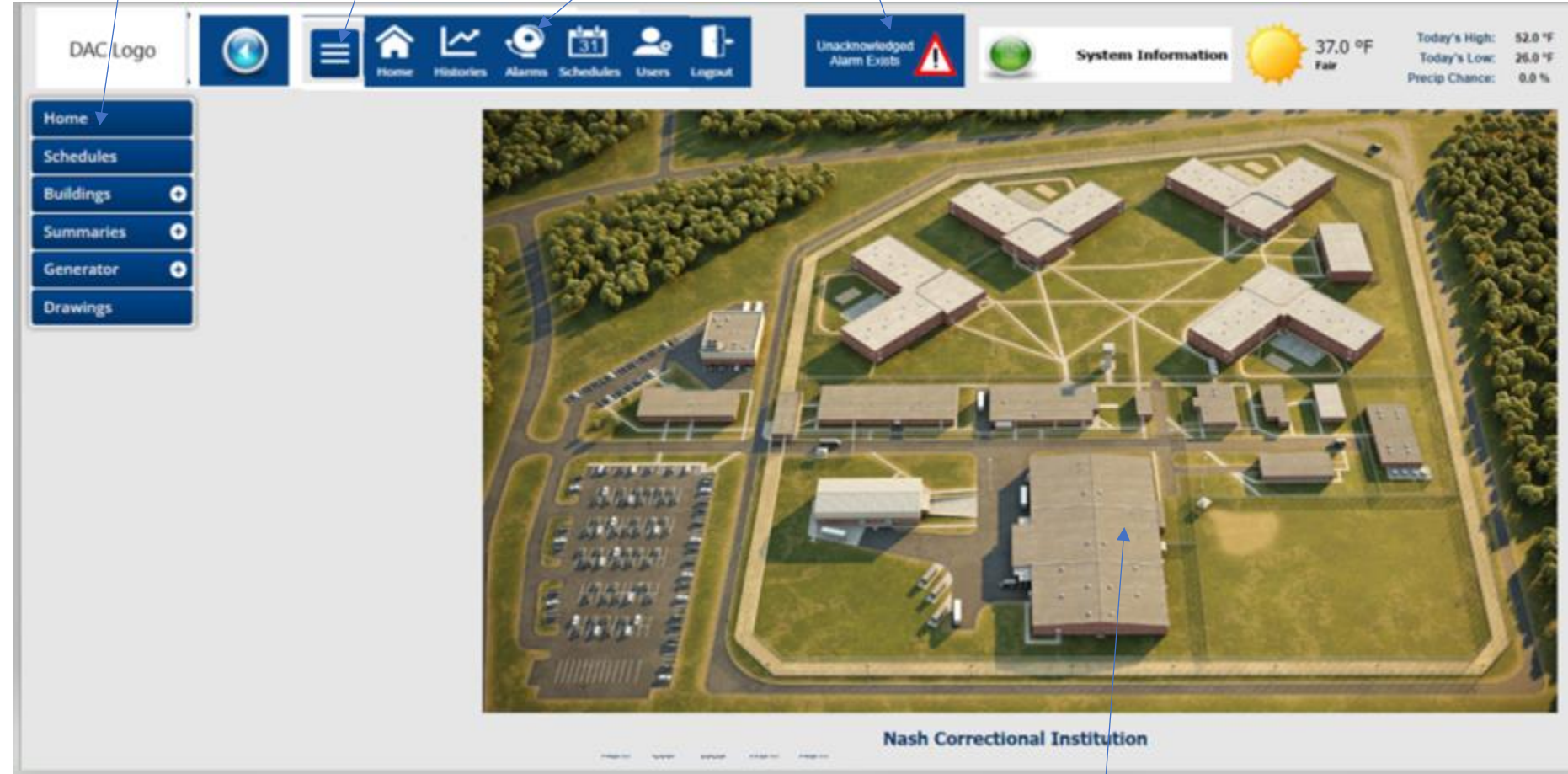
Side drop down menu. Typical all graphics. See Page 2

Selecting the menu button hides or displays the Side drop down menu

Menu across the top (typical all graphics): Background should be gray to match the overall background color for the graphic. Icons and letters should be blue to match the side menu

Both menus are standard on all web pages

Rename System Communication Status: Green: all modules communicating, Red, one or more are not communicating



Important Note! The standard or "canned" graphics that are provided with Tridium Niagara do not meet the level of detail and clarity for our standard graphics. Therefore they do not comply and are unacceptable.

Scale for 1920 x 1080 resolution

You can select a building to access the floor plans. Each floor of that building shall be selectable. Each floor level shall highlight when hovering over it indicating it is selectable and will bring up the related floorplan thermograph. See example Page 3

Page 2: Typical drop down menus

All Buildings and special systems (in this example the Generator Panel, but it could be electrical or water metering, etc.) will be listed whether included in the current system or not for future use.

Selecting a menu option with a "+" sign indicates a drop down menu with additional features

See Page 15 for Schedule Summary (all buildings)

- Home
- Schedules
- Buildings +
- Summaries +
- Generator +
- Drawings

- Home
- Schedules
- Buildings -
 - Admin Building +
 - Gatehouse +
 - Operations +
 - Vocational +
 - Segregation +
 - Medical +
 - Chapel +
 - Kitchen +
 - Unit 1 +
 - Unit 2 +
 - Unit 3 +
 - Unit 4 +
 - CoGen Plant +
 - Optical +
 - Print +
 - Generator Panel +
- Summaries +
- Generator +
- Drawings

Note a typical drop down menu for a building. This would include other systems as applicable such as heating and cooling plants.

- Unit 2 -
 - Overview
 - AHU 1
 - AHU 2
 - AHU 3
 - AHU 4
 - AHU 5
 - Exhaust Fans
- Unit 3 +
- Unit 4 +

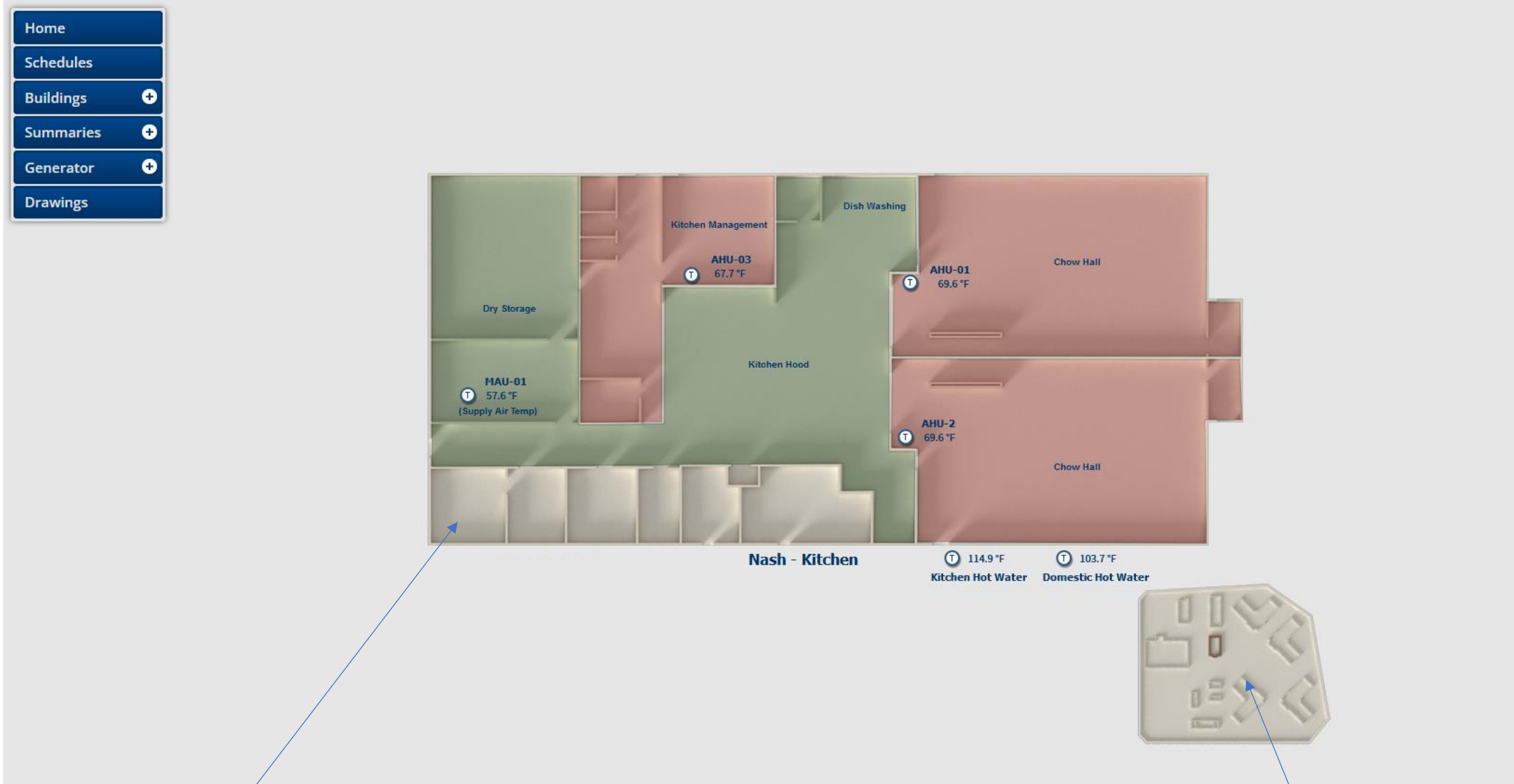
See Pages 10 & 11 for a typical system summaries

- Home
- Schedules
- Buildings +
- Summaries -
 - AHU Summary
 - HW Sys Summary
- Generator +
- Drawings

The Drawings page will pull up the shop drawing in their entirety. A separate document will be provided for O&M manuals for the BMS system, and, for the HVAC systems

- Home
- Schedules
- Buildings +
- Summaries +
- Generator -
 - Control Panel
 - Generator 1
 - Generator 2
- Drawings

Note temperature sensor details, and temperature values. Selecting **anywhere** in a zone will link you to that zone HVAC system. See **Page 4** for a typical system. Zones shall be clearly delineated between each other (provide a border around each zone)



Note the site map indicating the building at which you are looking. Currently this is a static graphic

Note typical floor plan color (tan). Ignore the green and red colors (that is a Tier 2 graphic requirement)

Page 4: Typical Equipment System (ex: AHU)

Each mouse button icon with right button depressed indicates this point can be adjusted.

Note Secondary Menu. Typical all equipment system pages

The top menu does not fully reflect all options. Refer to Page 1

Schedules relevant to this system. See Page 16

Provide horizontal menu as shown and discussed on this page. However, For Tier 1 graphics, perform the following: Gray out **Points** (no link to another page)

See Page 6 for typical Sequence graphic

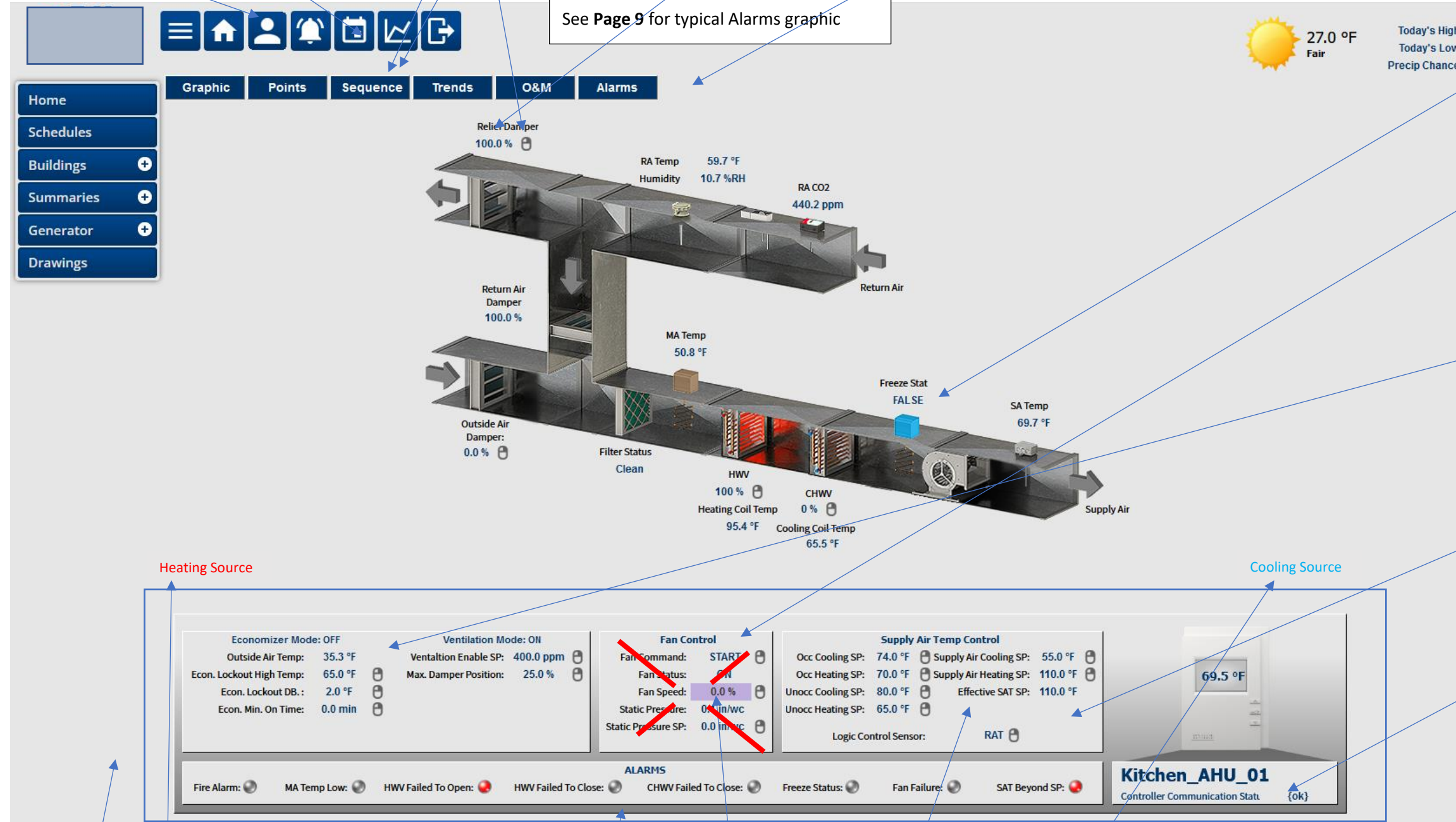
See Page 7 for typical Trends graphic

See Page 8 for typical O&M graphic

See Page 9 for typical Alarms graphic

Note 1: There are several items not currently shown on the graphic that shall be provided: As applicable, setpoints will be noted below the actual value. Valve and damper positions shall also reflect NO (normally open) and NC (normally closed) positions. Fan Command and Fan Status should be immediately beneath or above the fan. The position will also indicate position. Example: Relief damper shall indicate 100% **open**. The items above are typical all graphs

Provide another menu after "**Alarms**" called "**Help**" (Page 12) and "**Analytics**". See Page 18 for details-(gray out **Analytics** (no link to another page))



Today's High: 27.0 °F
Today's Low: Fair
Precip Chance:

Units for "Freeze" should be "Normal" or "Freeze Condition"

See Note 1 above Eliminate this section or use for other information as identified herein

Use this section to describe sequence status such as Economizer, Ventilation, Humidity mode, etc.

Use this section to list operating parameters. Note: Site user will not be able to change all these variables. Contact ECG/Energy Mgmt to discuss

Use the Icon below in lieu of "Controller Communications Status" Units to be "Good" or Off-line"



Alarm Override Offline

Provide location for this key (typ)

Note that all data/text is floating. Note conservative use of colors and how boxed framing is presented

Tier 1: This area to be for alarms only – no analytics

Provide a key for the Niagara colors used to denote overridden values, etc.

Do NOT use "Effective". Use "Active"

Note: Include links to the **heating source**, and **cooling source** below the graphic. Background color of link to match the overall graphic background color (transparent).

Provide a typed Sequence of Operations specific to this equipment system

Page 7: Typical Trends Page

Note a minimum of four standing trends. These are populated with standard points to assist the user in determining issues. Having to manually enter this information to create charts is not acceptable. However, you will be able to delete or add to the standing trends. Every setpoint and the data point associated with that setpoint shall be displayed in one of the trends below. Note you may want to group binary/digital, and, analog points separately. Final selection of points to be Central Engineering's (the owner's) choice

Note the options for each trend from the drop down menu as illustrated below

- Last 7 Days
- Auto
- Time Range
- Today
- Last 24 Hours
- Yesterday
- Week-To-Date
- Last Week
- Last 7 Days
- Month-To-Date
- Last Month
- Year-To-Date
- Last Year

The screenshot displays the 'AHU_02 Trends' interface. It includes a top navigation bar with icons for home, user, notifications, calendar, trends, O&M, and alarms. The left sidebar lists various buildings and units. The main area shows four trend graphs for 'Last 7 Days' and 'Today'. Below the graphs are control panels for Economizer Mode, Ventilation Mode, Fan Control, and Supply Air Temp Control. At the bottom, there is an 'ALARMS' section and a 'Kitchen_AHU_02' status box showing a temperature of 72.7°F.

Note the bottom section which is repeated from the (AHU) system graphic

The trends can be 4 to a page, or one to a page and scroll down for other pages. The controls contractor is to coordinate with the DAC Energy Manager regarding what points will be trended in each graph

Provide a link to the O&M manual here. Provide a link to the Shop drawings specific to this equipment system here

Alarms shall be specific to that system

Time Range ? to ? 57 Source(s) / 366 Alarm(s)

Info	Timestamp	Source	Message Text	Source State	Priority	Ack State	Alarm Class
<input type="checkbox"/>	24-Jan-23 12:51:37 PM EST	Boiler2Alarm HW_Plant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 11 Unacked	CriticalAlarmClass
<input type="checkbox"/>	24-Jan-23 12:49:46 PM EST	Boiler2_Alarm HW_Plant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 14 Unacked	CriticalAlarmClass
<input type="checkbox"/>	24-Jan-23 6:59:10 AM EST	Boiler1_Alarm HW_Plant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 37 Unacked	CriticalAlarmClass
<input type="checkbox"/>	24-Jan-23 6:00:53 AM EST	HWST_Alarm HW_Plant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 1 Unacked	CriticalAlarmClass
<input type="checkbox"/>	24-Jan-23 5:36:47 AM EST	Boiler1Alarm HW_Plant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 36 Unacked	CriticalAlarmClass
<input type="checkbox"/>	20-Jan-23 4:41:03 PM EST	CHWST_Alarm CHWPlant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 3 Unacked	CriticalAlarmClass
<input type="checkbox"/>	20-Jan-23 2:45:41 PM EST	CHWP3_Alarm CHWPlant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	19-Jan-23 2:06:56 PM EST	Polk_CI_J1:AHU_A_04 BAC-5051E_0056a5 Network 11000	Ping Success	Normal	255	0 Acked / 4 Unacked	Default Alarm Class
<input type="checkbox"/>	19-Jan-23 2:06:43 PM EST	Polk_CI_J1:AHU_A_04 FPB_4_02	Ping Success	Normal	255	0 Acked / 3 Unacked	Default Alarm Class
<input type="checkbox"/>	19-Jan-23 2:06:31 PM EST	Polk_CI_J1:AHU_A_04 FPB_4_01	Ping Success	Normal	255	0 Acked / 4 Unacked	Default Alarm Class
<input type="checkbox"/>	17-Jan-23 12:48:15 PM EST	CDWP2_Alarm CHWPlant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	17-Jan-23 12:48:15 PM EST	CDWP1_Alarm CHWPlant	Chiller Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	13-Jan-23 6:06:49 AM EST	Roxboro, Person County Airport, NC	Special Weather Statement	Normal	255	0 Acked / 3 Unacked	Default Alarm Class
<input type="checkbox"/>	12-Jan-23 10:44:15 AM EST	TowerFanRelayHigh Chiller2	Chiller Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	12-Jan-23 10:42:07 AM EST	TowerFanRelayLow Chiller2	Chiller Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	12-Jan-23 10:01:48 AM EST	FanAlarm AHU_C_13	Fan Has Returned To Normal!	Normal	255	0 Acked / 3 Unacked	CriticalAlarmClass
<input type="checkbox"/>	12-Jan-23 9:34:18 AM EST	FanAlarm AHU_C_12	Fan Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	11-Jan-23 2:27:03 PM EST	FanAlarm AHU_C_11	Fan Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	11-Jan-23 2:03:23 PM EST	FanAlarm AHU_C_10	Fan Has Returned To Normal!	Normal	255	0 Acked / 1 Unacked	CriticalAlarmClass
<input type="checkbox"/>	11-Jan-23 12:11:16 PM EST	Polk_CI_J1:NiagaraNetwork Polk_CI	Ping Success	Normal	255	0 Acked / 3 Unacked	Default Alarm Class
<input type="checkbox"/>	11-Jan-23 6:58:04 AM EST	Freezestat AHU_A_03	Freeze Status Has Returned To Normal!	Normal	255	0 Acked / 2 Unacked	CriticalAlarmClass
<input type="checkbox"/>	26-Dec-22 12:27:21 PM EST	Polk_CI_J1:AHU_A_10 FPB_10_21	Ping Success	Normal	255	0 Acked / 2 Unacked	Default Alarm Class
<input type="checkbox"/>	26-Dec-22 12:26:57 PM EST	Polk_CI_J1:AHU_A_10 FPB_10_20	Ping Success	Normal	255	0 Acked / 2 Unacked	Default Alarm Class
<input type="checkbox"/>	24-Dec-22 11:55:53 AM EST	Freezestat AHU_D_12	Freeze Status Has Returned To Normal!	Normal	255	0 Acked / 3 Unacked	CriticalAlarmClass
<input type="checkbox"/>	24-Dec-22 10:37:58 AM EST	Freezestat AHU_D_05	Freeze Status Has Returned To Normal!	Normal	255	0 Acked / 180 Unacked	CriticalAlarmClass

Acknowledge Hyperlink Notes Silence Filter Show Recurring

Page 10: Typical Summaries Page Typical Equipment Summary Pages: The tables below are representative in nature. The vast array of equipment systems will dictate which points are to be listed. There could be more, or, less. Coordinate with the Electronic Controls Group and the Energy Management Team to finalize this list. Units of measure are included for each variable. Final UOM are open to discussion.

System ID	Supply Air Temp	Supply Air Temp Setpt	Mixed Air Temp	CHW Coil Discharge Temp	Return Air Temp	Return Air Humidity	OA Damper Position	CHW Valve Position	CHW Coil Delta Temp	HW Valve Position	HW Coil Delta Temp	Fan Command	Fan Status	VFD Speed	Airflow	Duct Static Pressure	Duct Static Setpt	AHU Status	Heating Plant Status	HW Supply Temp	Cooling Plant Status	CHW Supply Temp
AHU_1	°F	°F	°F	°F	°F	% rh	% Open	% Open	°F	% Open	°F	On/Off/Hand	On/Off/Hand/Fail	%	cfm	in	in	On/Off/Hand/Fail	On/Off/Hand/Fail	°F	On/Off/Hand/Fail	°F
AHU_2																						

System ID	Zone Status	Room Temp	Room Setpt Heating	Room Setpt Cooling	Heating Setback Setpt	Cooling Setback Setpt	Room Setpt Adj	Active Room Setpt	Fan Induction Box Status	Reheat Vlv Position	VAV Discharge Temp	Reheat Delta T	VAV Airflow CFM	VAV Airflow Setpt	AHU Status	AHU Static Press	AHU Static Press SP	HWS Temp	HWR Temp	HW Delta
VAV_1	Occupied/Unoccupied/Override	°F	°F	°F	°F	°F	°F	°F	On/Off/Fail	% Open	°F	°F	cfm	cfm	On/Off/Hand/Fail	in	in	°F	°F	°F
VAV_2																				

System ID	Exhaust Command	Exhaust Status
Exhaust Fan 1	On/Off	On/Off/Hand/Fail
Exhaust Fan 1		

1. Provide a list of all point names (because they are typically abbreviated), the spelled-out name and purpose/function.
2. List each energy efficient sequence of operation (Optimal Start/Stop, Demand Limiting, Demand Ventilation, etc.). Provide a description here of that function, how it works, associated parameters (in the case of optimal start stop as an example: use of outside air temperature, building cooling capacity and building heating capacity (as a theoretical example). The owner will provide this information

1. This should include a flowchart (provided by the consultant) for typical issues and how to resolve them. This could be BMS related (sensor failure), or a mechanically related failure.



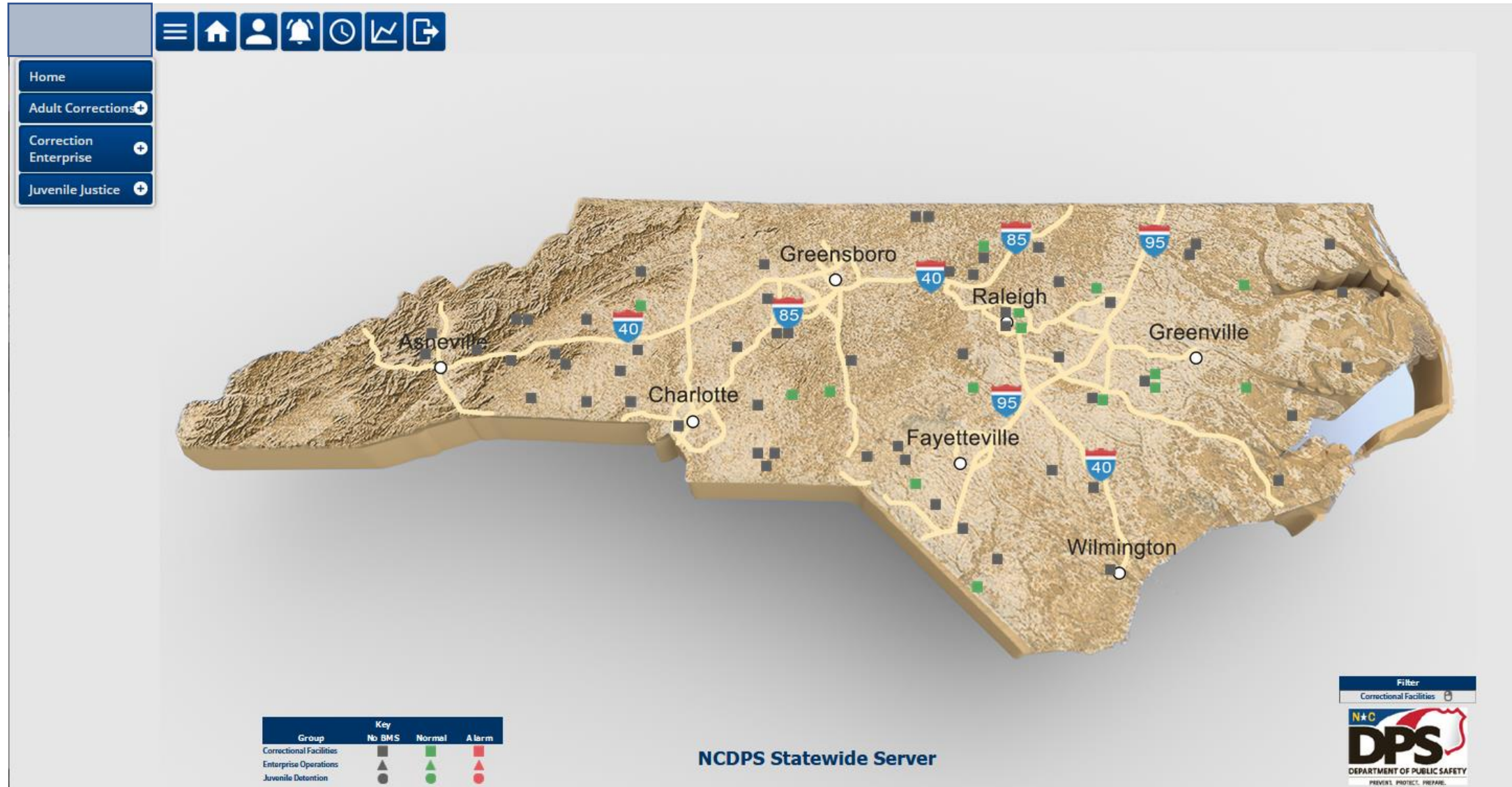
- Home
- Floorplans -
 - Admin Area -
 - First Floor A
 - First Floor B
 - First Floor C
 - Second Floor A
 - Second Floor B
 - Cells +
 - Dorms +
 - HCON +
- Equipment +
- CHW Plant
- HW Plant
- Equipment Summaries +
- Drawings +

Weekly Schedule | Special Events | Summary

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
3:00 AM							
6:00 AM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM	Occupied 5:00 AM - 5:00 PM
9:00 AM							
12:00 PM							
3:00 PM							
6:00 PM							
9:00 PM							

Event Start 12:00 AM | Event Finish 12:00 AM | Event Output Occupied

Admin Schedule



Page 18: Analytics:

- a. Not applicable to Tier 1 graphics

Revisions:

1/31/23: Page 4: Added key for alarm, override, offline. Added note that alarm section for Tier 1 is only alarms