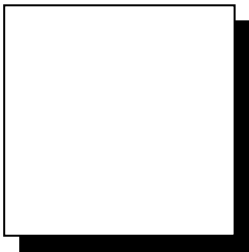
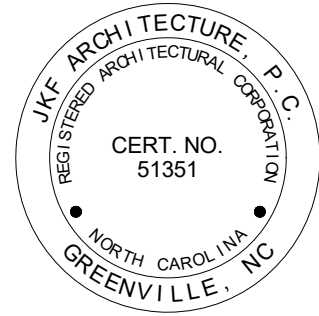


PROJECT MANUAL



NEW WELDING BUILDING
Greenville, NC

JKF Project No. 2022-07
SCO ID #22-251-91-01A
February 15, 2024



Specification No.



625 Lynndale Ct. Suite F
Greenville, NC 27858
252-355-1068 Phone
252-355-0216 Fax
jkf@jkf-arch.com

ADVERTISEMENT FOR BIDS

Sealed proposals will be received from Pre-Qualified Bidders by Pitt Community College, 1986 Pitt Tech Road, Winterville, NC 28590, attn: Mr. Glenn Sheppard, in Vernon White Room 12, up to 3:00 PM, Thursday, May 9, 2024, and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of:

PITT COMMUNITY COLLEGE NEW WELDING BUILDING SCO ID #22-25191-01A

Pre-Bid Meeting; Friday, April 19 2024, at 9:30 AM in Vernon White Room 12. Preferred Alternates will be reviewed at Pre-Bid Meeting.

Pre-Qualified Bidders

- Daniels & Daniels Construction Co., Inc.
- Hudson Brothers Construction Company
- T.A. Loving
- Monteith Construction Corp.
- Muter Construction, LLC
- Thomas Construction Group, LLC
- J.M. Thompson Company

Preferred Alternates under consideration:

- A. Door Hardware- IntelliKey .
- B. Simplex Fire Alarm System.
- C. Schneider Electric Building Systems
- D. Boilers- Lochinvar
- E. Chillers- Trane

Complete plans and specifications for this project can be obtained at JKF ARCHITECTURE, 625 Lynndale Ct., Suite F, Greenville, NC 27858, 252-355-1068, during normal office hours after April 5, 2024. Contact: jkf@jkf-arch.com

Plans and specifications available for viewing at JKF Architecture, Dodge Data & Analytics, ConstructConnect and DPI Printing, Greenville, NC.

Plan Deposit: \$300

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

Signed:

Glenn Sheppard, Assistant VP of Facilities

Pitt Community College
1986 Pitt Tech Road
Winterville, NC 28590

NOTICE TO BIDDERS

Sealed proposals will be received from Pre-Qualified Bidders by Pitt Community College, 1986 Pitt Tech Road, Winterville, NC 28590, attn: Mr. Glenn Sheppard, in Vernon White Room 12, up to 3:00 PM, Thursday, May 9, 2024, and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of:

PITT COMMUNITY COLLEGE NEW WELDING BUILDING SCO ID #22-25191-01A

Bids will be received for Contract type – (single prime); Category-General. All proposals shall be lump sum.

Pre-Qualified Bidders

- Daniels & Daniels Construction Co., Inc.
- Hudson Brothers Construction Company
- T.A. Loving
- Monteith Construction Corp.
- Muter Construction, LLC
- Thomas Construction Group, LLC
- J.M. Thompson Company

Pre-Bid Meeting

An open pre-bid meeting will be held Friday, April 19, 2024, 9:30 AM at Pitt Community College Vernon White Room 12. The meeting will address project specific questions, issues, bidding procedures and bid forms.

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:

- A. Door Hardware- Corbin-Russwin.
- B. Simplex Fire Alarm System.
- C. Schneider Electric Building Systems
- D. Boilers- Lochinvar
- E. Chillers- Trane

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

Contractors are hereby notified that they are encouraged, to the greatest extent practicable, to purchase American-made equipment and products with funding provided under this award.

- A. Complete plans, specifications and contract documents will be open for inspection in the office of Glenn Sheppard at Pitt Community College, Winterville, NC and JKF Architecture PC. Plans and specifications available for viewing at Dodge Data & Analytics, ConstructConnect and DPI Printing, Greenville, NC 27858, or may be obtained by those prime bidders, upon deposit of \$300 in cash or

company 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. PDF sets will be made available to all prime bidders provided they register with the Office of the Architect.

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

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

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

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

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:

JKF Architecture PC
625 Lynndale Ct.
Suite F
Greenville, NC 27858
252-355-1068
j kf@j kf-arch.com

Owner:

Glenn Sheppard, Assistant VP of Facilities
Pitt Community College
1986 Pitt Tech Road
Winterville, NC 28590
252-493-7593

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PITT COMMUNITY COLLEGE

NEW WELDING BUILDING

File #22-251-91-01A

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AND
GENERAL CONDITIONS OF THE CONTRACT**

STANDARD FORM FOR CONSTRUCTION PROJECTS

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

Form OC-15

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

Twenty Fourth Edition January 2013

INSTRUCTIONS TO BIDDERS

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

1. PROPOSALS

Proposals must be made in strict accordance with the Form of Proposal provided therefor, and all blank spaces for bids, alternates, and unit prices applicable to bidder's work shall be properly filled in. When requested alternates are not bid, the proposer shall so indicate by the words "No Bid". Any blanks shall also be interpreted as "No Bid". The bidder agrees that bid on Form of Proposal detached from specifications will be considered and will have the same force and effect as if attached thereto. Photocopied or faxed proposals will not be considered. Numbers shall be stated both in writing and in figures for the base bids and alternates. If figures and writing differ, the written number will supersede the figures.

Any modifications to the Form of Proposal (including alternates and/or unit prices) will disqualify the bid and may cause the bid to be rejected.

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

- a. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.
- b. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.
- c. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.
- d. If the proposal is made by a joint venture, it shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable.
- e. All signatures shall be properly witnessed.
- f. If the contractor's license of a bidder is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the proposal. The title "Licensee" shall appear under his/her signature.

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

Bidder shall identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts or an affidavit indicating work under contract will be self-performed, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f). Failure to comply with these requirements is grounds for rejection of the bid.

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

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

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

2. EXAMINATION OF CONDITIONS

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

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

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

3. BULLETINS AND ADDENDA

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

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

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

4. BID SECURITY

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company insured by the Federal Deposit Insurance Corporation, or a bid bond in an amount equal to not less than five percent (5%) of the proposal, said deposit to be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten (10) days after the award or to give satisfactory surety as required by law (G.S. 143-129).

Bid bond shall be conditioned that the surety will, upon demand, forthwith make payment to the obligee upon said bond if the bidder fails to execute the contract. The owner may retain bid securities of any bidder(s) who may have a reasonable chance of award of contract for the full duration of time stated in the Notice to Bidders. Other bid securities may be released sooner, at the discretion of the owner. All bid securities (cash or certified checks) shall be returned to the bidders promptly after award of contracts, and no later than seven (7) days after expiration of the holding period stated in the Notice to Bidders. Standard Form of Bid Bond is included in these specifications and shall be used.

5. RECEIPT OF BIDS

Bids shall be received in strict accordance with requirements of the General Statutes of North Carolina. Bid security shall be required as prescribed by statute. Prior to the closing of the bid, the bidder will be permitted to change or withdraw his bid. Guidelines for opening of public construction bids are available from the State Construction Office.

6. OPENING OF BIDS

Upon opening, all bids shall be read aloud. Once bidding is closed, there shall not be any withdrawal of bids by any bidder and no bids may be returned by the designer to any bidder. After the opening of bids, no bid may be withdrawn, except under the provisions of General Statute 143-129.1, for a period of thirty days unless otherwise specified. Should the successful bidder default and fail to execute a contract, the contract may be awarded to the next lowest and responsible bidder. The owner reserves the unqualified right to reject any and all bids. Reasons for rejection may include, but shall not be limited to, the following:

- a. If the Form of Proposal furnished to the bidder is not used or is altered.
- b. If the bidder fails to insert a price for all bid items, alternate and unit prices requested.
- c. If the bidder adds any provisions reserving the right to accept or reject any award.
- d. If there are unauthorized additions or conditional bids, or irregularities of any kind which tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.
- e. If the bidder fails to complete the proposal form where information is requested so the bid may be properly evaluated by the owner.
- f. If the unit prices contained in the bid schedule are unacceptable to the owner and the State Construction Office.
- g. If the bidder fails to comply with other instructions stated herein.

7. BID EVALUATION

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

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

- a. The latest financial statement showing assets and liabilities of the company or other information satisfactory to the owner.
- b. A listing of completed projects of similar size.
- c. Permanent name and address of place of business.
- d. The number of regular employees of the organization and length of time the organization has been in business under present name.
- e. The name and home office address of the surety proposed and the name and address of the responsible local claim agent.
- f. The names of members of the firms who hold appropriate trade licenses, together with license numbers.
- g. If prequalified, contractor info will be reviewed and evaluated comparatively to submitted prequalification package.

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

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

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

8. PERFORMANCE BOND

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

9. PAYMENT BOND

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

10. PAYMENTS

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

11. PRE-BID CONFERENCE

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

12. SUBSTITUTIONS

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

Submittals for proposed substitutions shall include the following information:

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

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

GENERAL CONDITIONS OF THE CONTRACT

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

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ARTICLE 1 - DEFINITIONS

- a. The **contract documents** consist of the Notice to Bidders; Instructions to Bidders; General Conditions of the Contract; special conditions if applicable; Supplementary General Conditions; the drawing and specifications, including all bulletins, addenda or other modifications of the drawings and specifications incorporated into the documents prior to their execution; the proposal; the contract; the performance bond; the payment bond; insurance certificates; the approval of the attorney general; and the certificate of the Office of State Budget and Management. All of these items together form the contract.
- b. The **owner** is the State of North Carolina through the agency named in the contract.
- c. The **designer(s)** are those referred to within this contract, or their authorized representatives. The Designer(s), as referred to herein, shall mean architect and/or engineer. They will be referred to hereinafter as if each were of the singular number, masculine gender.
- d. The **contractor**, as referred to hereinafter, shall be deemed to be either of the several contracting parties called the "Party of the First Part" in either of the several contracts in connection with the total project. Where, in special instances hereinafter, a particular contractor is intended, an adjective precedes the word "contractor," as "general," "heating," etc. For the purposes of a single prime contract, the term Contractor shall be deemed to be the single contracting entity identified as the "Party of the First Part" in the single Construction Contract. Any references or adjectives that name or infer multiple prime contractors shall be interpreted to mean the single prime Contractor.
- e. A **subcontractor**, as the term is used herein, shall be understood to be one who has entered into a direct contract with a contractor, and includes one who furnishes materials worked to a special design in accordance with plans and specifications covered by the contract, but does not include one who only sells or furnishes materials not requiring work so described or detailed.
- f. **Written notice** shall be defined as notice in writing delivered in person to the contractor, or to a partner of the firm in the case of a partnership, or to a member of the contracting organization, or to an officer of the organization in the case of a corporation, or sent to the last known business address of the contracting organization by registered mail.
- g. **Work**, as used herein as a noun, is intended to include materials, labor, and workmanship of the appropriate contractor.
- h. The **project** is the total construction work to be performed under the contract documents by the several contractors.
- i. **Project Expediter**, as used herein, is an entity stated in the contract documents, designated to effectively facilitate scheduling and coordination of work activities. See Article 14(f) for responsibilities of a Project Expediter. **For the purposes of a single prime contract, the single prime contractor shall be designated as the Project Expediter.**
- j. **Change order**, as used herein, shall mean a written order to the contractor subsequent to the signing of the contract authorizing a change in the contract. The change order shall be signed by the contractor, designer and the owner, and approved by the State Construction Office, in that order (Article 19).

- k. **Field Order**, as used herein, shall mean a written approval for the contractor to proceed with the work requested by owner prior to issuance of a formal Change Order. The field order shall be signed by the contractor, designer, owner, and State Construction Office.
- l. **Time of completion**, as stated in the contract documents, is to be interpreted as consecutive calendar days measured from the date established in the written Notice to Proceed, or such other date as may be established herein (Article 23).
- m. **Liquidated damages**, as stated in the contract documents [, is an amount reasonably estimated in advance to cover the consequential damages associated with the Owner's economic loss in not being able to use the Project for its intended purposes at the end of the contract's completion date as amended by change order, if any, by reason of failure of the contractor(s) to complete the work within the time specified. Liquidated damages does not include the Owner's extended contract administration costs (including but not limited to additional fees for architectural and engineering services, testing services, inspection services, commissioning services, etc.), such other damages directly resulting from delays caused solely by the contractor, or consequential damages that the Owner identified in the bid documents that may be impacted by any delay caused solely by the Contractor (e.g., if a multi-phased project-subsequent phases, delays in start other projects that are dependent on the completion of this Project, extension of leases and/or maintenance agreements for other facilities).
- n. **Surety**, as used herein, shall mean the bonding company or corporate body which is bound with and for the contractor, and which engages to be responsible for the contractor and his acceptable performance of the work.
- o. **Routine written communications between the Designer and the Contractor** are any communication other than a "request for information" provided in letter, memo, or transmittal format, sent by mail, courier, electronic mail, or facsimile. Such communications can not be identified as "request for information".
- p. **Clarification or Request for information (RFI)** is a request from the Contractor seeking an interpretation or clarification by the Designer relative to the contract documents. The RFI, which shall be labeled (RFI), shall clearly and concisely set forth the issue or item requiring clarification or interpretation and why the response is needed. The RFI must set forth the Contractor's interpretation or understanding of the contract documents requirements in question, along with reasons for such an understanding.
- q. **Approval** means written or imprinted acknowledgement that materials, equipment or methods of construction are acceptable for use in the work.
- r. **Inspection** shall mean examination or observation of work completed or in progress to determine its compliance with contract documents.
- s. **"Equal to" or "approved equal"** shall mean materials, products, equipment, assemblies, or installation methods considered equal by the bidder in all characteristics (physical, functional, and aesthetic) to those specified in the contract documents. Acceptance of equal is subject to approval of Designer and owner.
- t. **"Substitution" or "substitute"** shall mean materials, products, equipment, assemblies, or installation methods deviating in at least one characteristic (physical, functional, or aesthetic) from those specified, but which in the opinion of the bidder would improve competition and/or enhance the finished installation. Acceptance of substitution is subject to the approval of the Designer and owner.

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

ARTICLE 2 - INTENT AND EXECUTION OF DOCUMENTS

- a. The drawings and specifications are complementary, one to the other, and that which is shown on the drawings or called for in the specifications shall be as binding as if it were both called for and shown. The intent of the drawings and specifications is to establish the scope of all labor, materials, transportation, equipment, and any and all other things necessary to provide a bid for a complete job. In case of discrepancy or disagreement in the contract documents, the order of precedence shall be: Form of Contract, specifications, large-scale detail drawings, small-scale drawings.
- b. The wording of the specifications shall be interpreted in accordance with common usage of the language except that words having a commonly used technical or trade meaning shall be so interpreted in preference to other meanings.
- c. The contractor shall execute each copy of the proposal, contract, performance bond and payment bond as follows:
 - 1. If the documents are executed by a sole owner, that fact shall be evidenced by the word "Owner" appearing after the name of the person executing them.
 - 2. If the documents are executed by a partnership, that fact shall be evidenced by the word "Co-Partner" appearing after the name of the partner executing them.

3. If the documents are executed on the part of a corporation, they shall be executed by either the president or the vice president and attested by the secretary or assistant secretary in either case, and the title of the office of such persons shall appear after their signatures. The seal of the corporation shall be impressed on each signature page of the documents.
4. If the documents are made by a joint venture, they shall be executed by each member of the joint venture in the above form for sole owner, partnership or corporation, whichever form is applicable to each particular member.
5. All signatures shall be properly witnessed.
6. If the contractor's license is held by a person other than an owner, partner or officer of a firm, then the licensee shall also sign and be a party to the contract. The title "Licensee" shall appear under his/her signature.
7. The bonds shall be executed by an attorney-in-fact. There shall be attached to each copy of the bond a certified copy of power of attorney properly executed and dated.
8. Each copy of the bonds shall be countersigned by an authorized individual agent of the bonding company licensed to do business in North Carolina. The title "Licensed Resident Agent" shall appear after the signature.
9. The seal of the bonding company shall be impressed on each signature page of the bonds.
10. The contractor's signature on the performance bond and the payment bond shall correspond with that on the contract. The date of performance and payment bond shall not be prior to the date of the contract.

ARTICLE 3 - CLARIFICATIONS AND DETAIL DRAWINGS

- a. In such cases where the nature of the work requires clarification by the designer, such clarification shall be furnished by the designer with reasonable promptness by means of written instructions or detail drawings, or both. Clarifications and drawings shall be consistent with the intent of contract documents, and shall become a part thereof.
- b. The contractor(s) and the designer shall prepare, if deemed necessary, a schedule fixing dates upon which foreseeable clarifications will be required. The schedule will be subject to addition or change in accordance with progress of the work. The designer shall furnish drawings or clarifications in accordance with that schedule. The contractor shall not proceed with the work without such detail drawings and/or written clarifications.

ARTICLE 4 - COPIES OF DRAWINGS AND SPECIFICATIONS

The designer or Owner shall furnish free of charge to the contractors electronic copies of plans and specifications. If requested by the contractor, paper copies of plans and specifications shall be furnished free of charge as follows:

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

- b. Each other contractor - Up to six (6) sets of the appropriate drawings and specifications, up to three (3) sets of which shall include drawings and specifications of all other contracts, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.
- c. Additional sets shall be furnished at cost, including mailing, to the contractor upon request by the contractor. This cost shall be stated in the bidding documents.
- d. For the purposes of a single-prime contract, the contractor shall receive up to 30 sets of drawings and specifications, plus a clean set of black line prints on white paper of all appropriate drawings, upon which the contractor shall clearly and legibly record all work-in-place that is at variance with the contract documents.

ARTICLE 5 - SHOP DRAWINGS, SUBMITTALS, SAMPLES, DATA

- a. Within 15 consecutive calendar days after the notice to proceed, each prime contractor shall submit a schedule for submission of all shop drawings, product data, samples, and similar submittals through the Project Expediter to the Designer. This schedule shall indicate the items, relevant specification sections, other related submittal, data, and the date when these items will be furnished to the designer.
- b. The Contractor(s) shall review, approve and submit to the Designer all Shop Drawings, Coordination Drawings, Product Data, Samples, Color Charts, and similar submittal data required or reasonably implied by the Contract Documents. Required Submittals shall bear the Contractor's stamp of approval, any exceptions to the Contract Documents shall be noted on the submittals, and copies of all submittals shall be of sufficient quantity for the Designer to retain up to three (3) copies of each submittal for his own use plus additional copies as may be required by the Contractor. Submittals shall be presented to the Designer in accordance with the schedule submitted in paragraph (a). so as to cause no delay in the activities of the Owner or of separate Contractors.
- c. The Designer shall review required submittals promptly, noting desired corrections if any, and retaining three (3) copies (1 for the Designer, 1 for the owner and 1 for SCO) for his use. The remaining copies of each submittal shall be returned to the Contractor not later than twenty (20) days from the date of receipt by the Designer, for the Contractor's use or for corrections and resubmittal as noted by the Designer. When resubmittals are required, the submittal procedure shall be the same as for the original submittals.
- d. Approval of shop drawings/submittals by the Designer shall not be construed as relieving the Contractor from responsibility for compliance with the design or terms of the contract documents nor from responsibility of errors of any sort in the shop drawings, unless such lack of compliance or errors first have been called in writing to the attention of the Designer by the Contractor.

ARTICLE 6 - WORKING DRAWINGS AND SPECIFICATIONS AT THE JOB SITE

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

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

ARTICLE 7 - OWNERSHIP OF DRAWINGS AND SPECIFICATIONS

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

ARTICLE 8 - MATERIALS, EQUIPMENT, EMPLOYEES

- a. The contractor shall, unless otherwise specified, supply and pay for all labor, transportation, materials, tools, apparatus, lights, power, heat, sanitary facilities, water, scaffolding and incidentals necessary for the completion of his work, and shall install, maintain and remove all equipment of the construction, other utensils or things, and be responsible for the safe, proper and lawful construction, maintenance and use of same, and shall construct in the best and most workmanlike manner, a complete job and everything incidental thereto, as shown on the plans, stated in the specifications, or reasonably implied therefrom, all in accordance with the contract documents.
- b. All materials shall be new and of quality specified, except where reclaimed material is authorized herein and approved for use. Workmanship shall at all times be of a grade accepted as the best practice of the particular trade involved, and as stipulated in written standards of recognized organizations or institutes of the respective trades except as exceeded or qualified by the specifications.
- c. Upon notice, the contractor shall furnish evidence as to quality of materials.
- d. Products are generally specified by ASTM or other reference standard and/or by manufacturer's name and model number or trade name. When specified only by reference standard, the Contractor may select any product meeting this standard, by any manufacturer. When several products or manufacturers are specified as being equally acceptable, the Contractor has the option of using any product and manufacturer combination listed. However, the contractor shall be aware that the cited examples are used only to denote the quality standard of product desired and that they do not restrict bidders to a specific brand, make, manufacturer or specific name; that they are used only to set forth and convey to bidders the general style, type, character and quality of product desired; and that equivalent products will be acceptable. Request for substitution of materials, items, or equipment shall be submitted to the designer for approval or disapproval; such approval or disapproval shall be made by the designer prior to the opening of bids. Alternate materials may be requested after the award if it can clearly be demonstrated that it is an added benefit to the owner and the designer and owner approves.
- e. The designer is the judge of equality for proposed substitution of products, materials or equipment.

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

ARTICLE 9 - ROYALTIES, LICENSES AND PATENTS

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

ARTICLE 10 - PERMITS, INSPECTIONS, FEES, REGULATIONS

- a. The contractor shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work under this contract. If the contractor observes that the drawings and specifications are at variance therewith, he shall promptly notify the designer in writing. See Instructions to Bidders, Paragraph 3, Bulletins and Addenda. Any necessary changes required after contract award shall be made by change order in accordance with Article 19. If the contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules and regulations, and without such notice to the designer, he shall bear all cost arising therefrom. Additional requirements implemented after bidding will be subject to equitable negotiations.
- b. All work under this contract shall conform to the North Carolina State Building Code and other State, local and national codes as are applicable. The cost of all required inspections and permits shall be the responsibility of the contractor and included within the bid proposal. All water taps, meter barrels, vaults and impact fees shall be paid by the contractor unless otherwise noted.
- d. Projects constructed by the State of North Carolina or by any agency or institution of the State are not subject to inspection by any county or municipal authorities and are not subject to county or municipal building codes. The contractor shall, however, cooperate with the county or municipal authorities by obtaining building permits. Permits shall be obtained at no cost.
- e. Projects involving local funding (community colleges) are subject also to county and municipal building codes and inspection by local authorities. The contractor shall pay the cost of these permits and inspections.

ARTICLE 11 - PROTECTION OF WORK, PROPERTY AND THE PUBLIC

- a. The contractors shall be jointly responsible for the entire site and the building or construction of the same and provide all the necessary protections, as required by the owner or designer, and by laws or ordinances governing such conditions. They shall be responsible for any damage to the owner's property, or of that of others on the job, by them, their personnel, or their subcontractors, and shall make good such damages. They shall be responsible for and pay for any damages caused to the owner. All contractors shall have access to the project at all times.
- b. The contractor shall provide cover and protect all portions of the structure when the work is not in progress, provide and set all temporary roofs, covers for doorways, sash and windows, and all other materials necessary to protect all the work on the building, whether set by him, or any of the subcontractors. Any work damaged through the lack of proper protection or from any other cause, shall be repaired or replaced without extra cost to the owner.
- c. No fires of any kind will be allowed inside or around the operations during the course of construction without special permission from the designer and owner.
- d. The contractor shall protect all trees and shrubs designated to remain in the vicinity of the operations by building substantial boxes around same. He shall barricade all walks, roads, etc., as directed by the designer to keep the public away from the construction. All trenches, excavations or other hazards in the vicinity of the work shall be well barricaded and properly lighted at night.
- e. The contractor shall provide all necessary safety measures for the protection of all persons on the job, including the requirements of the A.G.C. *Accident Prevention Manual in Construction*, as amended, and shall fully comply with all state laws or regulations and North Carolina State Building Code requirements to prevent accident or injury to persons on or about the location of the work. He shall clearly mark or post signs warning of hazards existing, and shall barricade excavations, elevator shafts, stairwells and similar hazards. He shall protect against damage or injury resulting from falling materials and he shall maintain all protective devices and signs throughout the progress of the work.
- f. The contractor shall adhere to the rules, regulations and interpretations of the North Carolina Department of Labor relating to Occupational Safety and Health Standards for the Construction Industry (Title 29, Code of Federal Regulations, Part 1926, published in Volume 39, Number 122, Part II, June 24, 1974, *Federal Register*), and revisions thereto as adopted by General Statutes of North Carolina 95-126 through 155.
- g. The contractor shall designate a responsible person of his organization as safety officer/inspector to inspect the project site for unsafe health and safety hazards, to report these hazards to the contractor for correction, and whose duties also include accident prevention on the project, and to provide other safety and health measures on the project site as required by the terms and conditions of the contract. The name of the safety inspector shall be made known to the designer and owner at the time of the preconstruction conference and in all cases prior to any work starting on the project.
- h. In the event of emergency affecting the safety of life, the protection of work, or the safety of adjoining properties, the contractor is hereby authorized to act at his own discretion, without further authorization from anyone, to prevent such threatened injury or damage.

Any compensation claimed by the contractor on account of such action shall be determined as provided for under Article 19(b).

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

ARTICLE 12 - SEDIMENTATION POLLUTION CONTROL ACT OF 1973

- a. Any land-disturbing activity performed by the contractor(s) in connection with the project shall comply with all erosion control measures set forth in the contract documents and any additional measures which may be required in order to ensure that the project is in full compliance with the Sedimentation Pollution Control Act of 1973, as implemented by Title 15, North Carolina Administrative Code, Chapter 4, Sedimentation Control, Subchapters 4A, 4B and 4C, as amended (15 N.C.A.C. 4A, 4B and 4C).
- b. Upon receipt of notice that a land-disturbing activity is in violation of said act, the contractor(s) shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.
- c. The contractor(s) shall be responsible for defending any legal actions instituted pursuant to N.C.G.S. 113A-64 against any party or persons described in this article.
- d. To the fullest extent permitted by law, the contractor(s) shall indemnify and hold harmless the owner, the designer and the agents, consultants and employees of the owner and designer, from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss or expense is attributable to a violation of the Sedimentation Pollution Control Act. Such obligation shall not be construed to negate, abridge or otherwise reduced any other right or obligation of indemnity which would otherwise exist as to any party or persons described in this article.

ARTICLE 13 - INSPECTION OF THE WORK

- a. It is a condition of this contract that the work shall be subject to inspection during normal working hours and during any time work is in preparation and progress by the designer, designated official representatives of the owner, State Construction Office and those persons required by state law to test special work for official approval. The contractor shall therefore provide safe access to the work at all times for such inspections.
- b. All instructions to the contractor will be made only by or through the designer or his designated project representative. Observations made by official representatives of the owner shall be conveyed to the designer for review and coordination prior to issuance to the contractor.
- c. All work shall be inspected by designer, special inspector and/or State Construction Office prior to being covered by the contractor. Contractor shall give a minimum two weeks notice unless otherwise agreed to by all parties. If inspection fails, after the first reinspection all costs associated with additional reinspections shall be borne by the contractor.

- d. Where special inspection or testing is required by virtue of any state laws, instructions of the designer, specifications or codes, the contractor shall give adequate notice to the designer of the time set for such inspection or test, if the inspection or test will be conducted by a party other than the designer. Such special tests or inspections will be made in the presence of the designer, or his authorized representative, and it shall be the contractor's responsibility to serve ample notice of such tests.
- e. All laboratory tests shall be paid by the owner unless provided otherwise in the contract documents except the general contractor shall pay for laboratory tests to establish design mix for concrete, and for additional tests to prove compliance with contract documents where materials have tested deficient except when the testing laboratory did not follow the appropriate ASTM testing procedures.
- f. Should any work be covered up or concealed prior to inspection and approval by the designer, special inspector, and/or State Construction Office such work shall be uncovered or exposed for inspection, if so requested by the designer in writing. Inspection of the work will be made upon notice from the contractor. All cost involved in uncovering, repairing, replacing, recovering and restoring to design condition, the work that has been covered or concealed will be paid by the contractor involved.

ARTICLE 14 - CONSTRUCTION SUPERVISION AND SCHEDULE

- a. Throughout the progress of the work, each contractor shall keep at the job site, a competent superintendent and supervisory staff satisfactory to the designer and the owner. The superintendent and supervisory staff shall not be changed without the consent of the designer and owner unless said superintendent ceases to be employed by the contractor or ceases to be competent as determined by the contractor, designer or owner. The superintendent and other staff designated by the contractor in writing shall have authority to act on behalf of the contractor, and instructions, directions or notices given to him shall be as binding as if given to the contractor. However, directions, instructions, and notices shall be confirmed in writing.
- b. The contractor shall examine and study the drawings and specifications and fully understand the project design, and shall provide constant and efficient supervision to the work. Should he discover any discrepancies of any sort in the drawings or specifications, he shall report them to the designer without delay. He will not be held responsible for discrepancies in the drawings and/or specifications, but shall be held responsible to report them should they become known to him.
- c. All contractors shall be required to cooperate and consult with each other during the construction of this project. Prior to installation of work, all contractors shall jointly prepare coordination drawings, showing locations of various ductworks, piping, motors, pumps, and other mechanical or electrical equipment, in relation to the structure, walls and ceilings. These drawings shall be submitted to the designer through the Project Expediter for information only. Each contractor shall lay out and execute his work to cause the least delay to other contractors. Each contractor shall be financially responsible for any damage to other contractor's work and for undue delay caused to other contractors on the project.
- d. The contractor is required to attend job site progress conferences as called by the designer. The contractor shall be represented at these job progress conferences by both home office and project personnel. These representatives shall have authority to act on behalf of the contractor. These meetings shall be open to subcontractors, material

suppliers and any others who can contribute toward maintaining required job progress. It shall be the principal purpose of these meetings, or conferences, to effect coordination, cooperation and assistance in every practical way toward the end of maintaining progress of the project on schedule and to complete the project within the specified contract time. Each contractor shall be prepared to assess progress of the work as required in his particular contract and to recommend remedial measures for correction of progress as may be appropriate. The designer or his authorized representative shall be the coordinator of the conferences and shall preside as chairman. The contractor shall turn over a copy of his daily reports to the Designer and Owner at the job site progress conference. Owner will determine daily report format.

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

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

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

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

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

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

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

- h. The proposed project construction schedule shall be presented to the designer no later than fifteen (15) days after written notice to proceed. No application for payment will be processed until this schedule is accepted by the designer and owner.
- i. The approved project construction schedule shall be distributed to all contractors and displayed at the job site by the Project Expediter.
- j. The several contractors shall be responsible for their work activities and shall notify the Project Expediter of any necessary changes or adjustments to their work. The Project Expediter shall maintain the project construction schedule, making biweekly adjustments, updates, corrections, etc., that are necessary to finish the project within the Contract time, keeping all contractors and the designer fully informed. Copy of a bar chart schedule annotated to show the current progress shall be submitted by the Contractor(s) to the designer, along with monthly request for payment. For project requiring CPM schedule, the Contractor shall submit a biweekly report of the status of all activities. The bar chart schedule or status report shall show the actual Work completed to date in comparison with the original Work scheduled for all activities. If any activities of the work of several contractors are behind schedule, the contractor must indicate in writing, what measures will be taken to bring each such activity back on schedule and to ensure that the Contract Completion Date is not exceeded. A plan of action and recovery schedule shall be developed and submitted to the designer by the Project Expediter, when (1) the contractor's report indicates delays, that are in the opinion of the designer or the owner, of sufficient magnitude that the contractor's ability to complete the work by the scheduled completion is brought into question; (2) the updated construction schedule is thirty (30) days behind the planned or baseline schedule and no legitimate time extensions, as determined by the Designer, are in process; and (3) the contractor desires to make changes in the logic (sequencing of work) or the planned duration of future activities of the CPM schedule which, in the opinion of the designer or the owner, are of a major nature. The plan of action, when required shall be submitted to the Owner for review within two (2) business days of the Contractor receiving the Owner's written demand. The recovery schedule, when required, shall be submitted to the Owner within five (5) calendar days of the Contractor's receiving the Owner's written demand. Failure to provide an updated construction schedule or a recovery schedule may be grounds for rejection of payment applications or withholding of funds as set forth in Article 33.
- k. The Project Expediter shall notify each contractor of such events or time frames that are critical to the progress of the job. Such notice shall be timely and reasonable. Should the progress be delayed due to the work of any of the several contractors, it shall be the duty of the Project Expediter to immediately notify the contractor(s) responsible for such delay, the designer, the State Construction Office and other prime contractors. The designer shall determine the contractor(s) who caused the delays and notify the bonding company of the responsible contractor(s) of the delays; and shall make a recommendation to the owner regarding further action.
- l. Designation as Project Expediter entails an additional project control responsibility and does not alter in any way the responsibility of the contractor so designated, nor the

responsibility of the other contractors involved in the project. The project expeditor's Superintendent(s) shall be in attendance at the Project site at all times when work is in progress unless conditions are beyond the control of the Contractor or until termination of the Contract in accordance with the Contract Documents. It is understood that such Superintendent shall be acceptable to the Owner and Designer and shall be the one who will be continued in that capacity for the duration of the project unless he ceases to be on the Contractor's payroll or the Owner otherwise agrees. The Superintendent shall not be employed on any other project for or by the Contractor or by any other entity during the course of the Work. If the Superintendent is employed by the Contractor on another project without the Owner's approval, then the Owner may deduct from the Contractor's monthly general condition costs and amount representing the Superintendent's cost and shall deduct that amount for each month thereafter until the Contractor has the Superintendent back on the Owner's Project full-time.

ARTICLE 15 - SEPARATE CONTRACTS AND CONTRACTOR RELATIONSHIPS

- a. Effective from January 1, 2002, Chapter 143, Article 8, was amended, to allow public contracts to be delivered by the following delivery methods: single-prime, dual (single-prime and separate-prime), construction manager at risk, and alternative contracting method as approved by the State Building Commission. The owner reserves the right to prepare separate specifications, receive separate bids, and award separate contracts for such other major items of work as may be in the best interest of the State. For the purposes of a single prime contract, refer to Article 1 – Definitions.
- b. All contractors shall cooperate with each other in the execution of their work, and shall plan their work in such manner as to avoid conflicting schedules or delay of the work. See Article 14, Construction Supervision.
- c. If any part of contractor's work depends upon the work of another contractor, defects which may affect that work shall be reported to the designer in order that prompt inspection may be made and the defects corrected. Commencement of work by a contractor where such condition exists will constitute acceptance of the other contractor's work as being satisfactory in all respects to receive the work commenced, except as to defects which may later develop. The designer shall be the judge as to the quality of work and shall settle all disputes on the matter between contractors.
- d. Any mechanical or electrical work such as sleeves, inserts, chases, openings, penetrations, etc., which is located in the work of the general contractor shall be built in by the general contractor. The respective mechanical and electrical contractors shall set all sleeves, inserts and other devices that are to be incorporated into the structure in cooperation and under the supervision of the general contractor. The responsibility for the exact location of such items shall be that of the mechanical and/or electrical contractor.
- e. The designer and the owner shall have access to the work whenever it is in preparation and progress and during normal working hours. The contractor shall provide facilities for such access so the designer may perform his functions under the contract documents.
- f. Should a contractor cause damage to the work or property of another contractor, he shall be directly responsible, and upon notice, shall promptly settle the claim or otherwise resolve the dispute.

ARTICLE 16 - SUBCONTRACTS AND SUBCONTRACTORS

- a. Within thirty (30) days after award of the contract, the contractor shall submit to the designer, owner and to the State Construction Office a list giving the names and addresses of subcontractors and equipment and material suppliers he proposes to use, together with the scope of their respective parts of the work. Should any subcontractor be disapproved by the designer or owner, the designer or owner shall submit his reasons for disapproval in writing to the State Construction Office for its consideration with a copy to the contractor. If the State Construction Office concurs with the designer's or owner's recommendation, the contractor shall submit a substitute for approval. The designer and owner shall act promptly in the approval of subcontractors, and when approval of the list is given, no changes of subcontractors will be permitted except for cause or reason considered justifiable by the designer or owner.
- b. The designer will furnish to any subcontractor, upon request, evidence regarding amounts of money paid to the contractor on account of the subcontractor's work.
- c. The contractor is and remains fully responsible for his own acts or omissions as well as those of any subcontractor or of any employee of either. The contractor agrees that no contractual relationship exists between the subcontractor and the owner in regard to the contract, and that the subcontractor acts on this work as an agent or employee of the contractor.
- d. The owner reserves the right to limit the amount of portions of work to be subcontracted as hereinafter specified.

ARTICLE 17 - CONTRACTOR AND SUBCONTRACTOR RELATIONSHIPS

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

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

agreed upon on such unpaid balance as may be due. In addition to the above final payment provisions, periodic payments due a prime contractor during construction shall be paid in accordance with the payment provisions of the contract documents or said prime contractor shall be paid interest on any such unpaid amount at the rate stipulated above for delayed final payments. Such interest shall begin on the date the payment is due and continue until the date on which payment is made. Such due date may be established by the terms of the contract. Funds for payment of such interest on state-owned projects shall be obtained from the current budget of the owning department, institution or agency. Where a conditional acceptance of a contract exists, and where the owner is retaining a reasonable sum pending correction of such conditions, interest on such reasonable sum shall not apply.

- b. Within seven days of receipt by the prime contractor of each periodic or final payment, the prime contractor shall pay the subcontractor based on work completed or service provided under the subcontract. Should any periodic or final payment to the subcontractor be delayed by more than seven days after receipt of periodic or final payment by the prime contractor, the prime contractor shall pay the subcontractor interest, beginning on the eighth day, at the rate of one percent (1%) per month or fraction thereof on such unpaid balance as may be due.
- c. The percentage of retainage on payments made by the prime contractor to the subcontractor shall not exceed the percentage of retainage on payments made by the owner to the prime contractor. Any percentage of retainage on payments made by the prime contractor to the subcontractor that exceeds the percentage of retainage on payments made by the owner to the prime contractor shall be subject to interest to be paid by the prime contractor to the subcontractor at the rate of one percent (1%) per month or fraction thereof.
- d. Nothing in this section shall prevent the prime contractor at the time of application and certification to the owner from withholding application and certification to the owner for payment to the subcontractor for unsatisfactory job progress; defective construction not remedied; disputed work; third-party claims filed or reasonable evidence that claim will be filed; failure of subcontractor to make timely payments for labor, equipment and materials; damage to prime contractor or another subcontractor; reasonable evidence that subcontract cannot be completed for the unpaid balance of the subcontract sum; or a reasonable amount for retainage not to exceed the initial percentage retained by owner.

ARTICLE 18 - DESIGNER'S STATUS

- a. The designer shall provide general administration of the performance of construction contracts, including liaison and necessary inspection of the work to ensure compliance with plans and specifications. He is the agent of the owner only for the purpose of constructing this work and to the extent stipulated in the contract documents. He has authority to direct work to be performed, to stop work, to order work removed, or to order corrections of faulty work, where any such action by the designer may be necessary to assure successful completion of the work.
- b. The designer is the impartial interpreter of the contract documents, and, as such, he shall exercise his powers under the contract to enforce faithful performance by both the owner and the contractor, taking sides with neither.
- c. Should the designer cease to be employed on the work for any reason whatsoever, then the owner shall employ a competent replacement who shall assume the status of the former designer.

- d. The designer and his consultants will make inspections of the project. He will inspect the progress, the quality and the quantity of the work.
- e. The designer and the owner shall have access to the work whenever it is in preparation and progress during normal working hours. The contractor shall provide facilities for such access so the designer and owner may perform their functions under the contract documents.
- f. Based on the designer's inspections and evaluations of the project, the designer shall issue interpretations, directives and decisions as may be necessary to administer the project. His decisions relating to artistic effect and technical matters shall be final, provided such decisions are within the limitations of the contract.

ARTICLE 19 - CHANGES IN THE WORK

- a. The owner may have changes made in the work covered by the contract. These changes will not invalidate and will not relieve or release the contractor from any guarantee given by him pertinent to the contract provisions. These changes will not affect the validity of the guarantee bond and will not relieve the surety or sureties of said bond. All extra work shall be executed under conditions of the original contract.
- b. Except in an emergency endangering life or property, no change shall be made by the contractor except upon receipt of approved change order or written field order from the designer, countersigned by the owner and the state construction office authorizing such change. No claim for adjustments of the contract price shall be valid unless this procedure is followed.

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

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

- c. In determining the values of changes, either additive or deductive, contractors are restricted to the use of the following methods:
 - 1. Where the extra work involved is covered by unit prices quoted in the proposal, or subsequently agreed to by the Contractor, Designer, Owner and State Construction Office the value of the change shall be computed by application of unit prices based on quantities, estimated or actual as agreed of the items involved, except in such cases where a quantity exceeds the estimated quantity allowance in the contract by one hundred percent (100%) or more. In such cases, either party may elect to proceed under subparagraph c2 herein. If neither party elects to proceed under c2, then unit prices shall apply.
 - 2. The contracting parties shall negotiate and agree upon the equitable value of the change prior to issuance of the change order, and the change order shall stipulate the corresponding lump sum adjustment to the contract price.

- d. Under Paragraph "b" and Methods "c(2)" above, the allowances for overhead and profit combined shall be as follows: all contractors (the single contracting entity (prime), his subcontractors(1st tier subs), or their sub-subcontractors (2nd tier subs, 3rd tier subs, etc)) shall be allowed a maximum of 10% on work they each self-perform; the prime contractor shall be allowed a maximum of 5% on contracted work of his 1st tier sub; 1st tier, 2nd tier, 3rd tier, etc contractors shall be allowed a maximum of 2.5% on the contracted work of their subs. ; Under Method "c(1)", no additional allowances shall be made for overhead and profit. In the case of deductible change orders, under Method "c(2)" and Paragraph (b) above, the contractor shall include no less than five percent (5%) profit, but no allowances for overhead.
- e. The term "net cost" as used herein shall mean the difference between all proper cost additions and deductions. The "cost" as used herein shall be limited to the following:
1. The actual costs of materials and supplies incorporated or consumed as part of the work;
 2. The actual costs of labor expended on the project site; labor expended in coordination, change order negotiation, record document maintenance, shop drawing revision or other tasks necessary to the administration of the project are considered overhead whether they take place in an office or on the project site.
 3. The actual costs of labor burden, limited to the costs of social security (FICA) and Medicare/Medicaid taxes; unemployment insurance costs; health/dental/vision insurance premiums; paid employee leave for holidays, vacation, sick leave, and/or petty leave, not to exceed a total of 30 days per year; retirement contributions; worker's compensation insurance premiums; and the costs of general liability insurance when premiums are computed based on payroll amounts; the total of which shall not exceed thirty percent (30%) of the actual costs of labor;
 4. The actual costs of rental for tools, excluding hand tools; equipment; machinery; and temporary facilities required for the work;
 5. The actual costs of premiums for bonds, insurance, permit fees, and sales or use taxes related to the work.

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

- f. Should concealed conditions be encountered in the performance of the work below grade, or should concealed or unknown conditions in an existing structure be at variance with the conditions indicated by the contract documents, the contract sum and time for completion may be equitably adjusted by change order upon claim by either party made within thirty (30) days after the condition has been identified. The cost of such change shall be arrived at by one of the foregoing methods. All change orders shall be supported by a unit cost breakdown showing method of arriving at net cost as defined above.
- g. In all change orders, the procedure will be for the designer to request proposals for the change order work in writing. The contractor will provide such proposal and supporting data in suitable format. The designer shall verify correctness. Delay in the processing of the change order due to lack of proper submittal by the contractor of all required supporting data shall not constitute grounds for a time extension or basis of a claim. Within fourteen (14) days after receipt of the contractor's accepted proposal including all supporting documentation required by the designer, the designer shall prepare the change order and forward to the contractor for his signature or otherwise respond, in writing, to

the contractor's proposal. Within seven (7) days after receipt of the change order executed by the contractor, the designer shall, certify the change order by his signature, and forward the change order and all supporting data to the owner for the owner's signature. The owner shall execute the change order and forward to the State Construction Office for final approval, within seven (7) days of receipt. The State Construction Office shall act on the change order within seven (7) days. In case of emergency or extenuating circumstances, approval of changes may be obtained verbally by telephone or field orders approved by all parties, then shall be substantiated in writing as outlined under normal procedure.

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

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

- i. A change order, when issued, shall be full compensation, or credit, for the work included, omitted or substituted. It shall show on its face the adjustment in time for completion of the project as a result of the change in the work.
- j. If, during the progress of the work, the owner requests a change order and the contractor's terms are unacceptable, the owner, with the approval of the State Construction Office, may require the contractor to perform such work on a time and material basis whereupon the contractor shall proceed and keep accurately on such form as specified by the Designer or owner, a correct account of cost together with all proper invoices, payrolls and supporting data. Upon completion of the work a change order will be prepared with allowances for overhead and profit per paragraph d. above and "net cost" and "cost" per paragraph e. above. Without prejudice, nothing in this paragraph shall preclude the owner from performing or to have performed that portion of the work requested in the change order.

ARTICLE 20 - CLAIMS FOR EXTRA COST

- a. Should the contractor consider that as a result of instructions given by the designer, he is entitled to extra cost above that stated in the contract, he shall give written notice thereof to the designer within seven (7) days without delay. The written notice shall clearly state that a claim for extra cost is being made and shall provide a detailed justification for the extra cost. The contractor shall not proceed with the work affected until further advised, except in emergency involving the safety of life or property, which condition is covered in Article 19(b) and Article 11(h). No claims for extra compensation shall be considered unless the claim is so made. The designer shall render a written decision within seven (7) days of receipt of claim.
- b. The contractor shall not act on instructions received by him from persons other than the designer, and any claims for extra compensation or extension of time on account of such instruction will not be honored. The designer shall not be responsible for misunderstandings claimed by the contractor of verbal instructions which have not been confirmed in writing, and in no case shall instructions be interpreted as permitting a departure from the contract documents unless such instruction is confirmed in writing and supported by a properly authorized change order.
- c. Should a claim for extra compensation that complies with the requirements of (a) above by the contractor and is denied by the designer or owner, and cannot be resolved by a

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

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

ARTICLE 21 - MINOR CHANGES IN THE WORK

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

ARTICLE 22 - UNCORRECTED FAULTY WORK

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

ARTICLE 23 - TIME OF COMPLETION, DELAYS, EXTENSION OF TIME

- a. The time of completion is stated in the Supplementary General Conditions and in the Form of Construction Contract. The Project Expediter, upon notice of award of contract, shall prepare a construction schedule to complete the project within the time of completion as required by Article 14.
- b. The contractors shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the designer and shall fully complete all work hereunder within the time of completion stated. Time is of the essence and the contractor acknowledges the Owner will likely suffer financial damage for failure to complete the work within the time of completion. For each day in excess of the above number of days, the contractor(s) shall pay the owner the sum stated as liquidated damages reasonably estimated in advance to cover the losses to be incurred by the owner by reason of failure of said contractor(s) to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.
- c. In the event of multiple prime contractors, the designer shall be the judge as to the division of responsibility between the contractor(s), based on the construction schedule, weekly reports and job records, and shall apportion the amount of liquidated damages to be paid by each of them, according to delay caused by any or all of them.
- d. If the contractor is delayed at any time in the progress of his work solely by any act or negligence of the owner, the designer, or by any employee of either; by any separate contractor employed by the owner; by changes ordered in the work; by labor disputes at the project site; by abnormal weather conditions not reasonably anticipated for the locality where the work is performed; by unavoidable casualties; by any causes beyond the contractor's control; or by any other causes which the designer and owner determine may justify the delay, then the contract time may be extended by change order only for the time which the designer and owner may determine is reasonable.

Time extensions will not be granted for rain, wind, snow or other natural phenomena of normal intensity for the locality where work is performed. For purpose of determining extent of delay attributable to unusual weather phenomena, a determination shall be made by comparing the weather for the contract period involved with the average of the preceding five (5) year climatic range during the same time interval based on the National Oceanic and Atmospheric Administration National Weather Service statistics for the locality where work is performed and on daily weather logs kept on the job site by the contractor reflecting the effect of the weather on progress of the work and initialed by the designer's representative. No weather delays shall be considered after the building is dried in unless work claimed to be delayed is on the critical path of the baseline schedule or approved updated schedule. Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to compensable damages for delays. Any contractor claim for compensable damages for delays is limited to delays caused solely by the owner or its agents. Contractor caused delays shall be accounted for before owner or designer caused delays in the case of concurrent delays.

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

ARTICLE 24 - PARTIAL UTILIZATION/BENEFICIAL OCCUPANCY

- a. The owner may desire to occupy or utilize all or a portion of the project prior to the completion of the project.
- b. Should the owner request a utilization of a building or portion thereof, the designer shall perform a designer final inspection of area after being notified by the contractor that the area is ready for such. After the contractor has completed designer final inspection punch list and the designer has verified, then the designer shall schedule a beneficial occupancy inspection at a time and date acceptable to the owner, contractor(s) and State Construction Office. If beneficial occupancy is granted by the State Construction Office, in such areas the following will be established:
 - 1. The beginning of guarantees and warranties period for the equipment necessary to support. in the area.
 - 2. The owner assumes all responsibilities for utility costs for entire building.
 - 2. Contractor will obtain consent of surety.
 - 3. Contractor will obtain endorsement from insurance company permitting beneficial occupancy.
- c. The owner shall have the right to exclude the contractor from any part of the project which the designer has so certified to be substantially complete, but the owner will allow the contractor reasonable access to complete or correct work to bring it into compliance with the contract.
- d. Occupancy by the owner under this article will in no way relieve the contractor from his contractual requirement to complete the project within the specified time. The contractor will not be relieved of liquidated damages because of beneficial occupancy. The designer may prorate liquidated damages based on the percentage of project occupied.

ARTICLE 25 - FINAL INSPECTION, ACCEPTANCE, AND PROJECT CLOSEOUT

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

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

- b. At the SCO final inspection, the designer and his consultants shall, if job conditions warrant, record a list of items that are found to be incomplete or not in accordance with the contract documents. At the conclusion of the SCO final inspection, the designer and State Construction Office representative shall make one of the following determinations:
 - 1. That the project is completed and accepted.
 - 2. That the project will be accepted subject to the correction of the list of discrepancies (punch list). All punch list items must be completed within thirty (30) days of SCO final inspection or the owner may invoke Article 28, Owner's Right to Do Work.
 - 4. That the project is not complete and another date for a SCO final inspection will be established.
- c. Within fourteen (14) days of final acceptance per Paragraph b1 or within fourteen (14) days after completion of punch list per Paragraph b2 above, the designer shall certify the work and issue applicable certificate(s) of compliance.
- d. Any discrepancies listed or discovered after the date of SCO final inspection and acceptance under Paragraphs b1 or b2 above shall be handled in accordance with Article 42, Guarantee.
- f. The final acceptance date will establish the following:
 - 1. The beginning of guarantees and warranties period.
 - 2. The date on which the contractor's insurance coverage for public liability, property damage and builder's risk may be terminated.
 - 3. That no liquidated damages (if applicable) shall be assessed after this date.
 - 4. The termination date of utility cost to the contractor.
- g. Prior to issuance of final acceptance date, the contractor shall have his authorized representatives visit the project and give full instructions to the designated personnel regarding operating, maintenance, care, and adjustment of all equipment and special construction elements. In addition, the contractor shall provide to the owner a complete instructional video (media format acceptable to the owner) on the operation, maintenance, care and adjustment of all equipment and special construction elements.**

ARTICLE 26 - CORRECTION OF WORK BEFORE FINAL PAYMENT

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

- b. Correction of condemned work described above shall commence within twenty-four (24) hours after receipt of notice from the designer, and shall make satisfactory progress, as determined by the designer, until completed.
- c. Should the contractor fail to proceed with the required corrections, then the owner may complete the work in accordance with the provisions of Article 28.

ARTICLE 27 - CORRECTION OF WORK AFTER FINAL PAYMENT

See Article 35, Performance Bond and Payment Bond, and Article 42, Guarantee. Neither the final certificate, final payment, occupancy of the premises by the owner, nor any provision of the contract, nor any other act or instrument of the owner, nor the designer, shall relieve the contractor from responsibility for negligence, or faulty material or workmanship, or failure to comply with the drawings and specifications. Contractor shall correct or make good any defects due thereto and repair any damage resulting there from, which may appear during the guarantee period following final acceptance of the work except as stated otherwise under Article 42, Guarantee. The owner will report any defects as they may appear to the contractor and establish a time limit for completion of corrections by the contractor. The owner will be the judge as to the responsibility for correction of defects.

ARTICLE 28 - OWNER'S RIGHT TO DO WORK

If, during the progress of the work or during the period of guarantee, the contractor fails to prosecute the work properly or to perform any provision of the contract, the owner, after seven (7) days' written notice sent by certified mail, return receipt requested, to the contractor from the designer, may perform or have performed that portion of the work. The cost of the work may be deducted from any amounts due or to become due to the contractor, such action and cost of same having been first approved by the designer. Should the cost of such action of the owner exceed the amount due or to become due the contractor, then the contractor or his surety, or both, shall be liable for and shall pay to the owner the amount of said excess.

ARTICLE 29 - ANNULMENT OF CONTRACT

If the contractor fails to begin the work under the contract within the time specified, or the progress of the work is not maintained on schedule, or the work is not completed within the time above specified, or fails to perform the work with sufficient workmen and equipment or with sufficient materials to ensure the prompt completion of said work, or shall perform the work unsuitably or shall discontinue the prosecution of the work, or if the contractor shall become insolvent or be declared bankrupt or commit any act of bankruptcy or insolvency, or allow any final judgment to stand against him unsatisfied for a period of forty-eight (48) hours, or shall make an assignment for the benefit of creditors, or for any other cause whatsoever shall not carry on the work in an acceptable manner, the owner may give notice in writing, sent by certified mail, return receipt requested, to the contractor and his surety of such delay, neglect or default, specifying the same, and if the contractor within a period of seven (7) days after such notice shall not proceed in accordance therewith, then the owner shall, declare this contract in default, and, thereupon, the surety shall promptly take over the work and complete the performance of this contract in the manner and within the time frame specified. In the event the surety shall fail to take over the work to be done under this contract within seven (7) days after being so notified and notify the owner in writing, sent by certified mail, return receipt requested, that he is taking the same over and stating that he will diligently pursue and complete the same, the owner shall have full power and authority, without violating the contract, to take the prosecution of the work out of the hands of said contractor, to appropriate or use any or all contract materials and equipment on the grounds as may be suitable and acceptable and may enter into an agreement, either by public letting or negotiation, for the completion of said contract according to the terms and provisions thereof

or use such other methods as in his opinion shall be required for the completion of said contract in an acceptable manner. All costs and charges incurred by the owner, together with the costs of completing the work under contract, shall be deducted from any monies due or which may become due said contractor and surety. In case the expense so incurred by the owner shall be less than the sum which would have been payable under the contract, if it had been completed by said contractor, then the said contractor and surety shall be entitled to receive the difference, but in case such expense shall exceed the sum which would have been payable under the contract, then the contractor and the surety shall be liable and shall pay to the owner the amount of said excess.

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

- a. Should the work be stopped by order of a court having jurisdiction, or by order of any other public authority for a period of three months, due to cause beyond the fault or control of the contractor, or if the owner should fail or refuse to make payment on account of a certificate issued by the designer within forty-five (45) days after receipt of same, then the contractor, after fifteen (15) days' written notice sent by certified mail, return receipt requested, to the owner and the designer, may suspend operations on the work or terminate the contract.
- b. The owner shall be liable to the contractor for the cost of all materials delivered and work performed on this contract plus 10 percent overhead and profit and shall make such payment. The designer shall be the judge as to the correctness of such payment.

ARTICLE 31 - REQUEST FOR PAYMENT

- a. Not later than the fifth day of the month, the contractor shall submit to the designer a request for payment for work done during the previous month. The request shall be in the form agreed upon between the contractor and the designer, but shall show substantially the value of work done and materials delivered to the site during the period since the last payment, and shall sum up the financial status of the contract with the following information:
 1. Total of contract including change orders.
 2. Value of work completed to date.
 3. Less five percent (5%) retainage, provided however, that after fifty percent (50%) of the contractor's work has been satisfactorily completed on schedule, with approval of the owner and the State Construction Office and written consent of the surety, further requirements for retainage will be waived only so long as work continues to be completed satisfactorily and on schedule.
 4. Less previous payments.
 5. Current amount due.
- b. The contractor, upon request of the designer, shall substantiate the request with invoices of vouchers or payrolls or other evidence.
- c. Prior to submitting the first request, the contractor shall prepare for the designer a schedule showing a breakdown of the contract price into values of the various parts of the work, so arranged as to facilitate payments to subcontractors in accordance with Article 17, Contractor and Subcontractor Relationships. The contractor(s) shall list the

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

- d. When payment is made on account of stored materials and equipment, such materials must be stored on the owner's property, and the requests for payments shall be accompanied by invoices or bills of sale or other evidence to establish the owner's title to such materials and equipment. Such payments will be made only for materials that have been customized or fabricated specifically for this project. Raw materials or commodity products including but not limited to piping, conduit, CMU, metal studs and gypsum board may not be submitted. Responsibility for such stored materials and equipment shall remain with the contractor regardless of ownership title. Such stored materials and equipment shall not be removed from the owner's property. Should the space for storage on-site be limited, the contractor, at his option, shall be permitted to store such materials and/or equipment in a suitable space off-site. Should the contractor desire to include any such materials or equipment in his application for payment, they must be stored in the name of the owner in an independent, licensed, bonded warehouse approved by the designer, owner and the State Construction Office and located as close to the site as possible. The warehouse selected must be approved by the contractor's bonding and insurance companies; the material to be paid for shall be assigned to the owner and shall be inspected by the designer. Upon approval by the designer, owner and SCO of the storage facilities and materials and equipment, payment therefore will be certified. Responsibility for such stored materials and equipment shall remain with the contractor. Such stored materials and equipment shall not be moved except for transportation to the project site. Under certain conditions, the designer may approve storage of materials at the point of manufacture, which conditions shall be approved by the designer, the owner and the State Construction Office prior to approval for the storage and shall include an agreement by the storing party which unconditionally gives the State absolute right to possession of the materials at anytime. Bond, security and insurance protection shall continue to be the responsibility of the contractor(s).
- e. In the event of beneficial occupancy, retainage of funds due the contractor(s) may be reduced with the approval of the State Construction Office to an equitable amount to cover the list of items to be completed or corrected. Retainage may not be reduced to less than two and one-half (2 1/2) times the estimated value of the work to be completed or corrected. Reduction of retainage must be with the consent and approval of the contractor's bonding company.

ARTICLE 32 - CERTIFICATES OF PAYMENT AND FINAL PAYMENT

- a. Within five (5) days from receipt of request for payment from the contractor, the designer shall issue and forward to the owner a certificate for payment. This certificate shall indicate the amount requested or as approved by the designer. If the certificate is not approved by the designer, he shall state in writing to the contractor and the owner his reasons for withholding payment.
- b. No certificate issued or payment made shall constitute an acceptance of the work or any part thereof. The making and acceptance of final payment shall constitute a waiver of all claims by the owner except:
 - 1. Claims arising from unsettled liens or claims against the contractor.
 - 2. Faulty work or materials appearing after final payment.
 - 3. Failure of the contractor to perform the work in accordance with drawings and specifications, such failure appearing after payment.

4. As conditioned in the performance bond and payment bond.
- c. The making and acceptance of final payment shall constitute a waiver of all claims by the contractor except those claims previously made and remaining unsettled (Article 20(c)).
- d. Prior to submitting request for final payment to the designer for approval, the contractor shall fully comply with all requirements specified in the “project closeout” section of the specifications. These requirements include but not limited to the following:
 1. Submittal of Product and Operating Manuals, Warranties and Bonds, Guarantees, Maintenance Agreements, As-Built Drawings, Certificates of Inspection or Approval from agencies having jurisdiction. (The designer must approve the Manuals prior to delivery to the owner).
 2. Transfer of Required attic stock material and all keys in an organized manner.
 3. Record of Owner’s training.
 4. Resolution of any final inspection discrepancies.
 5. Granting access to Contractor’s records, if Owner’s internal auditors have made a request for such access pursuant to Article 52.
- e. The contractor shall forward to the designer, the final application for payment along with the following documents:
 1. List of minority business subcontractors and material suppliers showing breakdown of contract amounts and total actual payments to subs and material suppliers.
 2. Affidavit of Release of Liens.
 3. Affidavit of contractors of payment to material suppliers and subcontractors. (See Article 36).
 4. Consent of Surety to Final Payment.
 5. Certificates of state agencies required by state law.
- f. The designer will not authorize final payment until the work under contract has been certified by designer, certificates of compliance issued, and the contractor has complied with the closeout requirements. The designer shall forward the contractor’s final application for payment to the owner along with respective certificate(s) of compliance required by law.

ARTICLE 33 - PAYMENTS WITHHELD

- a. The designer with the approval of the State Construction Office may withhold payment for the following reasons:
 1. Faulty work not corrected.

2. The unpaid balance on the contract is insufficient to complete the work in the judgment of the designer.
 3. To provide for sufficient contract balance to cover liquidated damages that will be assessed.
- b. The secretary of the Department of Administration may authorize the withholding of payment for the following reasons:
 1. Claims filed against the contractor or evidence that a claim will be filed.
 2. Evidence that subcontractors have not been paid.
 - c. The Owner may withhold all or a portion of Contractor's general conditions costs set forth in the approved schedule of values, if Contractor has failed to comply with: (1) a request to access its records by Owner's internal auditors pursuant to Article 52; (2) a request for a plan of action and/or recovery schedule under Article 14.j or provide The Owner; (3) a request to provide an electronic copies of Contractor's baseline schedule, updates with all logic used to create the schedules in the original format of the scheduling software; and (4) Contractor's failure to have its Superintendent on the Project full-time; (
 - d. When grounds for withholding payments have been removed, payment will be released. Delay of payment due the contractor without cause will make owner liable for payment of interest to the contractor in accordance with G.S. 143-134.1. As provided in G.S.143-134.1(e) the owner shall not be liable for interest on payments withheld by the owner for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the owner or reasonable evidence that a third-party claim will be filed.

ARTICLE 34 - MINIMUM INSURANCE REQUIREMENTS

The work under this contract shall not commence until the contractor has obtained all required insurance and verifying certificates of insurance have been approved in writing by the owner. These certificates shall document that coverages afforded under the policies will not be cancelled, reduced in amount or coverages eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner of such alteration or cancellation. If endorsements are needed to comply with the notification or other requirements of this article copies of the endorsements shall be submitted with the certificates.

a. Worker's Compensation and Employer's Liability

The contractor shall provide and maintain, until final acceptance, workmen's compensation insurance, as required by law, as well as employer's liability coverage with minimum limits of \$100,000.

b. Public Liability and Property Damage

The contractor shall provide and maintain, until final acceptance, comprehensive general liability insurance, including coverage for premises operations, independent contractors, completed operations, products and contractual exposures, as shall protect such contractors from claims arising out of any bodily injury, including accidental death, as well as from claims for property damages which may arise from operations under this contract, whether such operations be by the contractor or by any subcontractor, or by

anyone directly or indirectly employed by either of them and the minimum limits of such insurance shall be as follows:

Bodily Injury: \$500,000 per occurrence
Property Damage: \$100,000 per occurrence / \$300,000 aggregate

In lieu of limits listed above, a \$500,000 combined single limit shall satisfy both conditions.

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

c. Property Insurance (Builder's Risk/Installation Floater)

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

d. Deductible

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

e. Other Insurance

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

f. Proof of Carriage

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

ARTICLE 35 - PERFORMANCE BOND AND PAYMENT BOND

- a. Each contractor shall furnish a performance bond and payment bond executed by a surety company authorized to do business in North Carolina. The bonds shall be in the full contract amount. Bonds shall be executed in the form bound with these specifications.
- b. All bonds shall be countersigned by an authorized agent of the bonding company who is licensed to do business in North Carolina.

ARTICLE 36 - CONTRACTOR'S AFFIDAVIT

The final payment of retained amount due the contractor on account of the contract shall not become due until the contractor has furnished to the owner through the designer an affidavit signed, sworn and notarized to the effect that all payments for materials, services or subcontracted work in connection with his contract have been satisfied, and that no claims or

liens exist against the contractor in connection with this contract. In the event that the contractor cannot obtain similar affidavits from subcontractors to protect the contractor and the owner from possible liens or claims against the subcontractor, the contractor shall state in his affidavit that no claims or liens exist against any subcontractor to the best of his (the contractor's) knowledge, and if any appear afterward, the contractor shall save the owner harmless.

ARTICLE 37 - ASSIGNMENTS

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

ARTICLE 38 - USE OF PREMISES

- a. The contractor(s) shall confine his apparatus, the storage of materials and the operations of his workmen to limits indicated by law, ordinances, permits or directions of the designer and owner and shall not exceed those established limits in his operations.
- b. The contractor(s) shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.
- c. The contractor(s) shall enforce the designer's and owner's instructions regarding signs, advertisements, fires and smoking.
- d. No firearms, any type of alcoholic beverages, or drugs (other than those prescribed by a physician) will be permitted at the job site.

ARTICLE 39 - CUTTING, PATCHING AND DIGGING

- a. The contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other contractors shown upon or reasonably implied by the drawings and specifications for the completed structure, as the designer may direct.
- b. Any cost brought about by defective or ill-timed work shall be borne by the party responsible therefor.
- c. No contractor shall endanger any work of another contractor by cutting, digging or other means. No contractor shall cut or alter the work of any other contractor without the consent of the designer and the affected contractor(s).

ARTICLE 40 - UTILITIES, STRUCTURES, SIGNS

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

- b. Meters shall be relisted in the owner's name on the day following final acceptance of the Project Expediter's work, and the owner shall pay for services used after that date.
- c. The owner shall be reimbursed for all metered utility charges after the meter is relisted in the owner's name and prior to completion and acceptance of the work of **all** contractors. Reimbursement shall be made by the contractor whose work has not been completed and accepted. If the work of two or more contractors has not been completed and accepted, reimbursement to the owner shall be paid by the contractors involved on the basis of assessments by the designer.
- d. Prior to the operation of permanent systems, the Project Expediter will provide temporary power, lighting, water, and heat to maintain space temperature above freezing, as required for construction operations.
- e. All contractors shall have the permanent building systems in sufficient readiness for furnishing temporary climatic control at the time a building is enclosed and secured. The HVAC systems shall maintain climatic control throughout the enclosed portion of the building sufficient to allow completion of the interior finishes of the building. A building shall be considered enclosed and secured when windows, doorways (exterior, mechanical, and electrical equipment rooms), and hardware are installed; and other openings have protection which will provide reasonable climatic control. The appropriate time to start the mechanical systems and climatic condition shall be jointly determined by the contractor(s), the designer and owner. Use of the equipment in this manner shall be subject to the approval of the Designer and owner and shall in no way affect the warranty requirements of the contractor(s).
- f. The electrical contractor shall have the building's permanent power wiring distribution system in sufficient readiness to provide power as required by the HVAC contractor for temporary climatic control.
- g. The electrical contractor shall have the building's permanent lighting system ready at the time the general contractor begins interior painting and shall provide adequate lighting in those areas where interior painting and finishing is being performed.
- h. Each prime contractor shall be responsible for his permanently fixed service facilities and systems in use during progress of the work. The following procedures shall be strictly adhered to:
 - 1. Prior to final acceptance of work by the State Construction Office, each contractor shall remove and replace any parts of the permanent building systems damaged through use during construction.
 - 2. Temporary filters as recommended by the equipment manufacturer in order to keep the equipment and ductwork clean and free of dust and debris shall be installed in each of the heating and air conditioning units and at each return grille during construction. New filters shall be installed in each unit prior to the owner's acceptance of the work.
 - 3. Extra effort shall be maintained to keep the building and the site adjacent to the building clean and under no circumstances shall air systems be operated if finishing and site work operations are creating dust in excess of what would be considered normal if the building were occupied.
 - 4. It shall be understood that any warranty on equipment presented to the owner shall extend from the day of final acceptance by the owner. The cost of warranting the

equipment during operation in the finishing stages of construction shall be borne by the contractor whose system is utilized.

5. The electrical contractor shall have all lamps in proper working condition at the time of final project acceptance.
 - i. The Project Expediter shall provide, if required and where directed, a shed for toilet facilities and shall furnish and install in this shed all water closets required for a complete and adequate sanitary arrangement. These facilities will be available to other contractors on the job and shall be kept in a neat and sanitary condition at all times. Chemical toilets are acceptable.
 - j. The Project Expediter shall, if required by the Supplementary General Conditions and where directed, erect a temporary field office, complete with lights, telephone, heat and air conditioning. A portion of this office shall be partitioned off, of sufficient size, for the use of a resident inspector, should the designer so direct.
 - k. On multi-story construction projects, the Project Expediter shall provide temporary elevators, lifts, or other special equipment for the general use of all contractors. The cost for such elevators, lifts or other special equipment and the operation thereof shall be included in the Project Expediter's bid.
 - l. The Project Expediter will erect one sign on the project if required. The sign shall be of sound construction, and shall be neatly lettered with black letters on white background. The sign shall bear the name of the project, and the names of prime contractors on the project, and the name of the designer and consultants. Directional signs may be erected on the owner's property subject to approval of the owner with respect to size, style and location of such directional signs. Such signs may bear the name of the contractor and a directional symbol. No other signs will be permitted except by permission of the owner.

ARTICLE 41 - CLEANING UP

- a. The contractors shall keep the building and surrounding area reasonably free from rubbish at all times, and shall remove debris from the site on a timely basis or when directed to do so by the designer or Project Expediter. The Project Expediter shall provide an on site refuse container(s) for the use of all contractors. Each contractor shall remove their rubbish and debris from the building on a daily basis. The Project Expediter shall broom clean the building as required to minimize dust and dirt accumulation.
- b. The Project Expediter shall provide and maintain suitable all-weather access to the building.
- c. Before final inspection and acceptance of the building, each contractor shall clean his portion of the work, including glass, hardware, fixtures, masonry, tile and marble (using no acid), clean and wax all floors as specified, and completely prepare the building for use by the owner, with no cleaning required by the owner.

ARTICLE 42 - GUARANTEE

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

- b. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturer's warranty period.
- c. Additionally, the owner may bring an action for latent defects caused by the negligence of the contractor which is hidden or not readily apparent to the owner at the time of beneficial occupancy or final acceptance, whichever occurred first, in accordance with applicable law.
- d. Guarantees for roof, equipment, materials, and supplies shall be stipulated in the specifications sections governing such roof, equipment, materials, or supplies.

ARTICLE 43 - CODES AND STANDARDS

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

ARTICLE 44 - INDEMNIFICATION

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

ARTICLE 45 - TAXES

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

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

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

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

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

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

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

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

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

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

ARTICLE 46 - EQUAL OPPORTUNITY CLAUSE

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

ARTICLE 47 - EMPLOYMENT OF INDIVIDUALS WITH DISABILITIES

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

ARTICLE 48 - ASBESTOS-CONTAINING MATERIALS (ACM)

The State of North Carolina has attempted to address all asbestos-containing materials that are to be disturbed in the project. However, there may be other asbestos-containing materials in the work areas that are not to be disturbed and do not create an exposure hazard.

Contractors are reminded of the requirements of instructions under Instructions to Bidders and General Conditions of the Contract, titled Examination of Conditions. Statute 130A, Article 19, amended August 3, 1989, established the Asbestos Hazard Management Program that controls asbestos abatement in North Carolina. The latest edition of *Guideline Criteria for Asbestos Abatement* from the State Construction Office is to be incorporated in all asbestos abatement projects for the Capital Improvement Program.

ARTICLE 49 - MINORITY BUSINESS PARTICIPATION

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

ARTICLE 50 – CONTRACTOR EVALUATION

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

ARTICLE 51 – GIFTS

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

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

ARTICLE 52 – AUDITING-ACCESS TO PERSONS AND RECORDS

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

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

ARTICLE 53 – NORTH CAROLINA FALSE CLAIMS ACT

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

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

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

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

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

ARTICLE 54 – TERMINATION FOR CONVENIENCE

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

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

SUPPLEMENTARY GENERAL CONDITIONS

SUPPLEMENTS

The following supplements added to the "Instructions to Bidders and General Conditions of the Contract" of the Division of State Construction, North Carolina Department of Administration, Twenty Fourth Edition January 2013. Where any article of the General Conditions is modified by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Class shall remain in effect.

Article 1

- i. The project expediter shall be the General Contractor.

Article 23

- a. Add: "1. The Contractor shall be issued a Notice to Proceed under this agreement on a date to be specified in a written order from the Designer and shall fully complete all work hereunder within 425 consecutive calendar for Base Bid days from said date. Additional days and conditions for days related to the acceptance of Alternate Bid items or Unit Prices are described in the Contract Documents. For each day in excess of the above number of days, the Contractor(s) shall pay to the Owner the sum of ONE THOUSAND DOLLARS (\$1,000.00) 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 material consideration thereof.

Article 34

Modify Paragraph C as follows:

“The contractor shall purchase and maintain property insurance during the life of this contract, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the owner, the contractor, the subcontractors and sub subcontractors in the work and shall insure **against risks of direct physical loss – (all perils)**. 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.”

END OF SUPPLEMENTARY CONDITIONS

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

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

SECTION A: INTENT

It is the intent of these guidelines that the State of North Carolina, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded shall cooperate and in good faith do all things legal, proper and reasonable to achieve the statutory goal of ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to or to make purchases of materials or equipment from minority-business contractors or minority-business subcontractors who do not submit the lowest responsible, responsive bid or bids.

SECTION B: DEFINITIONS

1. Minority - a person who is a citizen or lawful permanent resident of the United States and who is:
 - a. Black, that is, a person having origins in any of the black racial groups in Africa;
 - b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
 - c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, the Pacific Islands;
 - d. American Indian, that is, a person having origins in any of the original peoples of North America; or
 - e. Female
2. Minority Business - means a business:
 - a. In which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and
 - b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.
3. Socially and economically disadvantaged individual - means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".
4. Public Entity - means State and all public subdivisions and local governmental units.
5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.
6. Designer – Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.
7. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

8. Contract - A mutually binding legal relationship or any modification thereof obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.
9. Contractor - Any person, firm, partnership, corporation, association, or joint venture which has contracted with the State of North Carolina to perform construction work or repair.
10. Subcontractor - A firm under contract with the prime contractor or construction manager at risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in his subcontract.

SECTION C: RESPONSIBILITIES

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

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

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

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

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

2. State Construction Office

The State Construction Office will be responsible for the following:

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

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

3. Owner

Before awarding a contract, owner shall do the following:

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

4. Designer

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

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

corresponding total dollar value of the bid and affidavit listing Good Faith Efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award.

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

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

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

- a. Attend the scheduled prebid conference.
- b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
- c. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification will include the following:
 - (1) A description of the work for which the subbid is being solicited.
 - (2) The date, time and location where subbids are to be submitted.
 - (3) The name of the individual within the company who will be available to answer questions about the project.
 - (4) Where bid documents may be reviewed.
 - (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

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

- d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
- e. Identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).
- f. Make documentation showing evidence of implementation of PM, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
- g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
- h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
- i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), “MBE Documentation for Contract Payment” – (Appendix E), for designer’s review.
- j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office in writing, of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.

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

6. Minority Business Responsibilities

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

SECTION 4: DISPUTE PROCEDURES

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

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

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

MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

APPLICATION:

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

MINORITY BUSINESS SUBCONTRACT GOALS:

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

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

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

OR

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

OR

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

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

MINIMUM COMPLIANCE REQUIREMENTS:

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

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

- (1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.
- (2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.
- (3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.
- (4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- (5) Attending any prebid meetings scheduled by the public owner.
- (6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.
- (7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- (8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- (9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- (10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

APPENDIX E

MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: _____

Address & Phone: _____

Project Name: _____

Pay Application #: _____ Period: _____

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

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

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

Date: _____ Approved/Certified By: _____

Name

Title

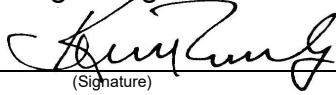
Signature

SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT

Statement of Special Inspections

Project: PITT Community College New Welding Building
Location: Winterville, North Carolina
Owner's Representative:
Owner's Address:

This Statement of Special Inspections is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the 2018 North Carolina State Building Code. It includes a Schedule of Special Inspection Services applicable to this project as well as the name of the Special Inspector and the identity of other approved agencies intended to be retained for conducting these inspections. This Statement of Special Inspections was prepared by the following Designers of Record:

Structural	Kevin M. Roomsburg, P.E.		2/15/2024
	(Type or print name)	(Signature)	(Date)
Architectural	John K. Farkas, AIA		
	(Type or print name)	(Signature)	(Date)
Mechanical			
	(Type or print name)	(Signature)	(Date)
Other			
	(Type or print name)	(Signature)	(Date)

The Special Inspector shall keep records of all inspections and shall furnish inspection reports to the State Construction Office and the Designers of Record. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the State Construction Office and the Designers of Record. The Special Inspections program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the State Construction Office, Owner, and the Designers of Record.

Interim Report Frequency: Monthly

A Final Report of Special Inspections documenting completion of all required Special Inspections and correction of any discrepancies should be submitted prior to issuance of a Certificate of Use and Occupancy.

Job Site safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Authorization

Accepted for the SCO by:

Signature

Date

Signature

Date

Schedule of Special Inspection Services

The following sheets comprise the required schedule of special inspections for this project. The construction divisions which require special inspections for this project are as follows.

- | | |
|--|--|
| <input checked="" type="checkbox"/> Structural Steel | <input type="checkbox"/> Sprayed Fire Resistant Material |
| <input checked="" type="checkbox"/> Cold-Formed Steel Framing | <input type="checkbox"/> Intumescent Fire-Resistant Coatings |
| <input checked="" type="checkbox"/> Concrete Construction | <input type="checkbox"/> Exterior Insulation & Finish System |
| <input checked="" type="checkbox"/> Masonry – Level 1 ^a | <input type="checkbox"/> Smoke Control |
| <input type="checkbox"/> Wood Construction | <input type="checkbox"/> Retaining Walls Exceeding 5 Feet |
| <input checked="" type="checkbox"/> Soils | <input type="checkbox"/> Wind-Resisting Components (1705.4) ^b |
| <input type="checkbox"/> Driven Deep Foundations | <input type="checkbox"/> Wind Requirements (1706) ^c |
| <input type="checkbox"/> Cast-in-Place Deep Foundations | <input type="checkbox"/> Seismic Resistance ^d |
| <input type="checkbox"/> Helical Pile Foundations | |

a. Occupancy Category IV structures, as defined by 1604.5 of the North Carolina Building Code, may require Level 2 inspection of masonry construction. The SER shall review Code sections 1704.5.1 and 1704.5.3 and adjust the Schedule of Special Inspection Services as needed.

b. Special inspections for Wind Resistance are applicable to those areas defined by 1704.6.2 of the North Carolina Building Code. Wind Resistance Special Inspections are only effective if the 1704.6.2 base triggers apply.

c. Special Inspections for Seismic Resistance are applicable to those structures defined by 1704.6.1 of the North Carolina Building Code. Seismic Requirements are only effective if the 1704.6.1 base triggers apply.

Inspection Agents	Qualifications	Address
1. Special Inspector Kevin M. Roomsburg, P.E. NRW Engineering, P.C.	SI	748 Lord Dunmore Drive Virginia Beach, VA 23464
2. Structural Engineer of Record Kevin M. Roomsburg, P.E.	SER	748 Lord Dunmore Drive Virginia Beach, VA 23464
3. Testing Laboratory Terracon	ITL	314 Beacon Drive Winterville, NC 28590
4. Other		

Note: The inspection and testing agent shall be engaged by the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the State Construction Office, prior to commencing work.

Seismic Design Category: A B C D

Nominal Wind Speed: 90-109mph 110-119mph ≥120mph

Wind Exposure Category: B C D

Schedule of Special Inspection Services
Structural Steel

Item	Qualifications	Scope
1. Fabricator Certification/Quality Control Procedures	1 1	<ul style="list-style-type: none"> Ensure fabricator meets the requirements of NCSBC 1704.2.2 Collect certificate of compliance from fabricator at completion of fabrication
2. Welding	3 3 3 1	<ul style="list-style-type: none"> Continuous inspection of complete and partial joint penetration welds, multipass fillet welds, plug and slot welds, and single-pass fillet welds > 5/16" in accordance with NCSBC Table 1704.3 Periodic inspection of single-pass fillet welds ≤ 5/16" Collect certificate of compliance for weld filler material Identify use of approved filler material and in accordance with AWS D1.1
3. Metal Deck	1 3	<ul style="list-style-type: none"> Collect material data sheets for decking and connectors or fasteners Periodic inspection of welds and / or mechanical fasteners
4. Structural Details	3	<ul style="list-style-type: none"> Periodic inspection of steel framing and joint details
5. Bolting	1 1 3 N/A	<ul style="list-style-type: none"> Collect material data sheets for bolts, nuts, and washers Collect certificate of compliance from bolt supplier Periodic inspection of snug-tight, pretensioned, and slip critical joints in accordance with NCSBC Table 1704.3 Continuous inspection of pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation
6. Material Certification	1	<ul style="list-style-type: none"> Collect certified mill test reports

Schedule of Special Inspection Services
Cold-Formed Steel Framing

Item	Qualifications	Scope
1. Plant Certification/ Quality Control Procedures for Pre- Engineered Wall Panels Assembled Off-Job Site	1 1	<ul style="list-style-type: none"> • Ensure wall panel fabricator meets the requirements of NCSBC 1704.2.2 • Collect certificate of compliance from wall panel fabricator at completion of fabrication
2. Mechanical Connections	3	<ul style="list-style-type: none"> • Periodic inspection of all field connections including anchorage to the structural frame
3. Welding	3	<ul style="list-style-type: none"> • Periodic inspection of all field connections including anchorage to the structural frame
4. Framing Details	3	<ul style="list-style-type: none"> • Periodic inspection framing and details
5. Cold-formed Steel Trusses	N/A	<ul style="list-style-type: none"> • For trusses clear spanning 60 feet or more, verify that both temporary and permanent restraints and braces are installed in accordance with the approved truss submittal package.

Schedule of Special Inspection Services
Concrete Construction

Item	Qualifications	Scope
1. Mix Design/Material Certifications	1	<ul style="list-style-type: none"> Collect mix designs and verify appropriate mix use during specific installation
2. Reinforcement Installation	1/3 1 N/A	<ul style="list-style-type: none"> Periodic inspection of reinforcing steel, including prestressing tendons and welded wire fabric Collection of certified mill test reports Continuous inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5b
3. Concrete Placement/Monitoring Fresh Concrete, Sampling & prep of test samples	3 3 3 N/A 3 3	<ul style="list-style-type: none"> Continuous inspection of cast-in-place concrete placement Continuous monitoring of sampling of fresh concrete, slump test, air content test, temperature of concrete and creation of strength test specimens Periodic inspection of formwork Periodic verification of concrete strength prior to removal of shores and forms from beams and structural slabs Continuous inspection of bolts to be installed in concrete prior to and during placement Periodic inspection of anchors installed in hardened concrete
4. Curing & Protection	3	<ul style="list-style-type: none"> Periodic inspections of curing techniques
5. Structural Precast Concrete Members	N/A	<ul style="list-style-type: none"> Periodic inspection of attachment of precast members
6. Post-Tensioned Concrete Members	N/A N/A N/A	<ul style="list-style-type: none"> Periodic verification of posttensioned concrete strength (f'_{ci}) prior to force transfer Continuous inspection of force application to prestressing tendons Continuous inspection of grouting procedures at bonded prestressing tendons included in the lateral force resisting system

Schedule of Special Inspection Services
Masonry

Item	Qualifications	Scope
1. Material Certification	1 1 1	<ul style="list-style-type: none"> • Collect mix design for mortar • Collect mix design for grout • Certificates of Compliance for masonry constituents
2. Mixing of Mortar & Grout	2 2	<ul style="list-style-type: none"> • Periodic inspection of site prepared mortar, site-prepared grout, and grout for bonded tendons • Continuous verification of slump flow and VSI as self-consolidating grout is delivered to the site
3. Installation of Masonry	3 3 1	<ul style="list-style-type: none"> • Periodic inspection of construction of mortar joints, prior to beginning masonry construction and during construction • Periodically verify the type, size, and location of anchors and their attachment to the structure • Periodically verify size and location of structural elements
4. Reinforcement Installation	1 N/A 1 N/A N/A	<ul style="list-style-type: none"> • Verify location of reinforcement and connections to structure as construction begins • Continuous inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5b • Prior to grouting periodically verify size, grade, and placement of reinforcement and connection of masonry to structural frame • Periodically verify prestressing technique • During construction, continuously monitor the application and measurement of prestressing force
5. Grouting Operations	3 3 N/A	<ul style="list-style-type: none"> • Prior to grouting, periodically verify conforming cleanliness of grout space and placement of the reinforcement and connectors • Continuous observation of the placement of all grout • Continuously observe the grouting of prestressing bonded tendons
6. Weather Protection	3	<ul style="list-style-type: none"> • Periodically verify protection techniques for construction of masonry below 40°F and above 90°F
7. Observation of the Evaluation of Masonry Strength	3	<ul style="list-style-type: none"> • Periodic observation of the preparation of grout specimens, mortar specimens and or prisms.

Schedule of Special Inspection Services
Soils

Item	Qualifications	Scope
1.Site Preparation	3	<ul style="list-style-type: none"> • Determine that the subgrade has been prepared in accordance with the approved soils report and the construction document
2. Fill Placement	3 3	<ul style="list-style-type: none"> • Periodic classification and testing of compacted fill materials • Continuous observation of materials used, densities, and lift thickness ensuring compliance with the approved soils report and the construction documents
3. Evaluation	3	<ul style="list-style-type: none"> • Determine that the materials below shallow foundations are adequate to achieve the design bearing capacity

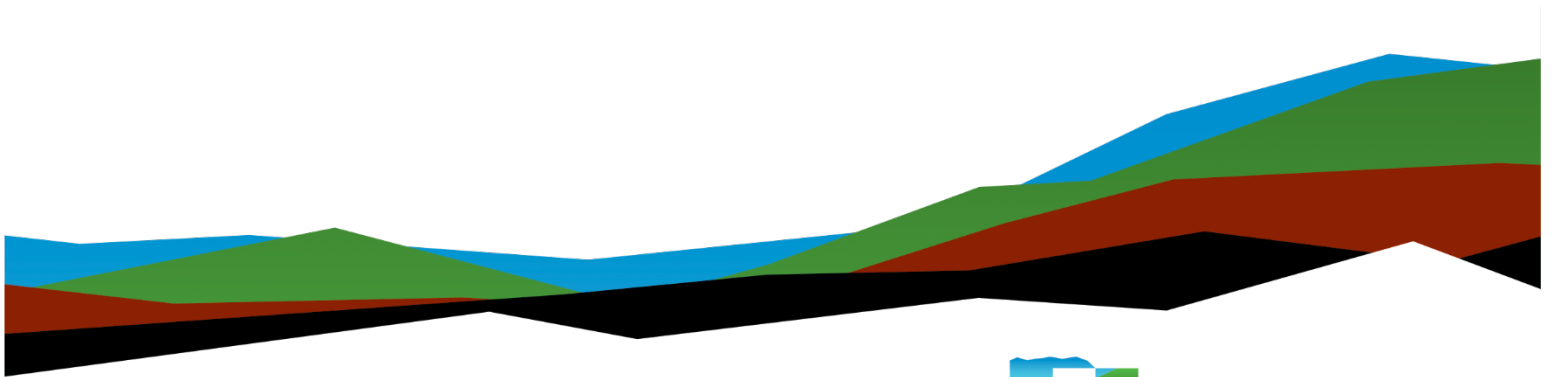
Pitt Community College – Welding Building

Geotechnical Engineering Report

May 3, 2023 | Terracon Project No. 72235023

Prepared for:

Pitt Community College
PO Box 7007
Greenville, North Carolina 27835



Nationwide

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May 3, 2023

Pitt Community College
PO Box 7007
Greenville, North Carolina 27835

Attn: Mr. Ricky Brown
P: (252) 493-7200
E: rbrown@email.pittcc.edu

Re: Geotechnical Engineering Report
Pitt Community College – Welding Building
1966 Warren Drive
Winterville, North Carolina
Terracon Project No. 72235023

Dear Mr. Brown :

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P72235023 dated March 7, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Gunnar H. Goslin
Staff Professional

Andrew J. Gliniak, PE
Project Engineer
NC Registered 042183

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Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Report Summary

Topic ¹	Overview Statement ²
Project Description	Construction of a new single-story steel framed welding building with approximately 29,000 square feet of office and workspace, with associated parking.
Geotechnical Characterization	Our subsurface exploration generally encountered loose to medium dense sands interbedded with soft to medium stiff clays. Groundwater is anticipated at depths of 5 to 8 feet.
Seismic Design	Site Classification is D
Earthwork	Clayey subgrade soils are sensitive to moisture variation and earthwork during warmer periods of the year are recommended. Isolated foundation undercut and replacement could be required, to depths of approximately 4 feet to remove softer soils that may not be improved during earthwork such as encountered at sounding C-9.
Shallow Foundations	With subgrade prepared as noted in Earthwork , shallow foundations are recommended for building support Allowable bearing pressure = 2,000 psf Expected settlements: < 1-inch total, < 1/2-inch differential
Pavements	With subgrade prepared as noted in Earthwork . Concrete: <ul style="list-style-type: none"> ■ 5 inches Portland Cement Concrete (PCC) in Light Duty to Medium Duty areas. ■ 7 inches PCC over 4 inches GB in Heavy Duty areas (e.g., aprons and dumpster pad) Asphalt: <ul style="list-style-type: none"> ■ 3 inches Asphaltic Concrete (AC) over 6 inches granular base (GB) in Light Duty areas ■ 4 inches AC over 8 inches GB in Medium Duty areas (e.g., drive lanes)
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Pitt Community College – Welding Building to be located at 1966 Warren Drive in Winterville, North Carolina. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification
- Site preparation and earthwork
- Foundation design and construction
- Floor slab design and construction
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the [Site Location](#) and [Exploration Plan](#), respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and/or as separate graphs in the [Exploration Results](#) section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Email communication on February 21, 2023, with Mr. John Farkas including a conceptual plan drawing of the planned development and preferred test locations
Project Description	Construction of a new single-story steel framed welding building with approximately 29,000 square feet of office- and workspace with associated parking. The building will be slab-on-grade (non-basement).

Item	Description
Building Construction	Steel frame CMU Walls
Finished Floor Elevation	Finished floor elevation is anticipated to be near existing grade
Maximum Loads	We have assumed the maximum following loads: <ul style="list-style-type: none"> ■ Columns: 100 kips (assumed) ■ Walls: 5 kips per linear foot (klf) assumed ■ Slabs: 125 pounds per square foot (psf) assumed
Grading	Up to 2 feet of cut and fill is expected to be required to develop final grade, excluding remedial grading requirements.
Free-Standing Retaining Walls	None.
Pavements	We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered. Anticipated traffic is as follows: <ul style="list-style-type: none"> ■ Autos/light trucks: 300 vehicles per day ■ Light delivery and trash collection vehicles: 10 vehicles per week ■ Tractor-trailer trucks: <1 vehicle per week The pavement design period is 20 years.
Building Code	2018 North Carolina State Building Code (based on 2015 International Building Code).

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
<p>Parcel Information</p>	<p>The project is located at 1966 Warren Drive in Winterville, North Carolina. Latitude/Longitude (approximate) 35.5549/-77.4108 See Site Location</p>
<p>Existing Improvements</p>	<p>Reference to our site visit and according to Google Earth™ historical aerial imagery, the site the site is an agriculture field since at least 1985.</p>
<p>Current Ground Cover</p>	<p>Mostly grass covered.</p>
<p>Existing Topography</p>	<p>The project site area is mostly relatively level in the central and eastern portions at approximate elevation 70 feet. Elevations in the northwest and western portions of the site gently slope from 70 feet to 62 feet based on publicly available topography maps published through the Pitt County Online Parcel Information System (OPIS).</p>

We also collected photographs at the time of our field exploration program. Representative photos are provided in our [Photography Log](#).

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the previous subsurface explorations by others, the recent Terracon subsurface explorations, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel. CPT GeoModel layers displayed include surficial materials.

Model Layer	Layer Name	General Description
1	Looser Sand and Clay	Behaves as sands and dense sands
2	Sand and Clay	Behaves as clays and silts
3	Denser Sand	Medium dense to dense sand

All test locations were performed in an agricultural field and some encountered topsoil ranging from approximately 1 to 3 inches. In our experience, tilled topsoil in agriculture fields should be expected to range up to approximately 12-inches.

Groundwater

Groundwater, where encountered, was measured between 5 feet and 8 feet below existing grades during field exploration at the test locations. Based on the measured water levels at the test locations, cave in depths, CPT data, and moisture condition of the soil samples, groundwater is anticipated at a depth of 5 feet below the existing ground surface.

The soundings were advanced hydraulically in the dry that allows short term groundwater observations to be made after advancement. Groundwater depths recorded after sounding are noted on the CPT Logs in the appendix. Groundwater conditions may be different at the time of construction. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project.

Geology

The site is located within the Coastal Plain physiographic province. The Coastal Plain is typically characterized by marine, alluvial, and aeolian sediments that were deposited during periods of fluctuating sea levels and moving shorelines. Overburden soils include sedimentary marine and alluvial interbedded gravel, sand, silt, and clay. Many of the clays have been preconsolidated by desiccation from frequent rising and lowering of the sea level and groundwater table. Deeper basal formations are typical of those laid down in a shallow sloping sea bottom; dense sand, consolidated clay, limestone, chalk, marl, claystone, and sandstone.

According to USGS Mineral Resources On-Line Spatial Data based on the 1998 digital equivalent of the 1985 Geologic Map of North Carolina, the site is mapped within the Yorktown and Duplin Formation (Tertiary).

Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the 2018 North Carolina Building Code. Based on the soil properties observed at the site and as described on the exploration logs and results, our professional opinion is for that a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of 60 feet. The site properties below the boring depth to 60 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

Liquefaction

Based on the results of the soundings, liquefaction is not expected after the recommended earthwork and relatively low level of ground motions associated with the design earthquake.

Geotechnical Overview

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided that the recommendations provided in this report are implemented in the design and construction phases of this project.

The subsurface materials consisted of relatively loose tilled sandy soil, loose to medium dense sand and soft to medium stiff clay underlain by relatively denser sand at the test locations. We recommend that site cut be limited to depths of 3 feet to help avoid the groundwater table and vibratory rolling the subgrade after cutting to design grades after stripping topsoil.

Based on our laboratory testing, on-site material will likely have a natural moisture content higher than the soil's plastic limit, which may indicate unstable subgrade material. For this reason, we recommend that contingencies be placed in the budget for

subgrade repairs to be determined during construction. Performing earthwork operations during warmer periods of the year and raising site grades will reduce the potential for problems associated with wet, unstable subgrades. Low ground pressure/tracked equipment could be required for site preparation.

After stripping topsoil and once any areas of cut are excavated to proposed subgrade elevation, the exposed subgrade soils in the building and pavement footprints should be densified in place using a medium weight vibratory roller. The purpose of the rolling is to densify the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. Static rolling and additional repairs should be anticipated for areas too wet for vibratory rolling.

Based on the conditions encountered and estimated load-settlement relationships, the proposed structure can be supported on conventional continuous or spread footings after additional site preparation as recommended in the **Earthwork** section. Isolated foundation undercut could be required to a depth of 4 feet to remove softer/looser soil (such as encountered in Sounding C-9) not improved by rolling. Grading for the proposed foundations should incorporate the limits of the foundations plus a lateral distance beyond the outside edge of footings, where space is available. On-site sand is considered suitable to be used as engineered fill materials with moisture conditioning.

A rigid or flexible pavement system is suitable for this site. The **Pavements** section addresses the design of pavement systems supported on the densified existing soils or structural fill.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Low ground pressure/tracked equipment could be required due to the looser soils in the upper 5 feet encountered of the soundings. Complete stripping of the topsoil should be

performed in the proposed building and parking/driveway areas. Topsoil thickness was noted in Geotechnical Characterization, however, farm fields can contain deeper topsoil and organic matter. Topsoil may be reused in areas of the site to be landscaped but should not be used as structural fill or backfill.

Subgrade Preparation

After stripping and removing topsoil and once any areas of cut have been excavated to proposed subgrade elevation, the exposed subgrade soils in the building and pavement footprints should be densified in place using a medium weight vibratory roller. The purpose of the vibratory rolling is to densify the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The roller should make at least six passes across the site, with the second set of three passes perpendicular to the first set of three passes with intermittent vibration activated. If water is brought to the surface by the vibratory rolling, the operation should be discontinued until the water subsides. Vibratory rolling should be completed during dry weather. Static rolling and additional repairs should be anticipated for areas too wet for vibratory rolling.

After the vibratory rolling, pore pressures should be allowed to dissipate for a minimum of 16 hours. After the waiting period, proofrolling should be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation with a lightly loaded/empty dump truck prior to placing fill or a loaded, tandem-axle dump truck (15 to 20 ton total vehicle weight) after placing fill or similar rubber-tired construction equipment. Proofrolling is recommended as a means of detecting areas of soft or unstable subgrade soils. The proofrolling should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proofrolling operations should be observed by a representative of the geotechnical engineer. Subgrade soils that exhibit excessive rutting or deflection during proofrolling should be repaired as directed by the field representative. Typical repairs include overexcavation followed by replacement with either properly compacted fill or by a subgrade stabilization fabric in conjunction with a sand fill or crushed stone.

If subgrade soils are unsuitable, they will require removal and replacement; however, if they are unstable due to excessive moisture, the most economical solution for remediation may be to scarify, dry and recompact the material. This remediation is most effective during the typically hotter months of the year (May to October). If construction is performed during the cooler period of the year, the timeline for scarifying, drying, and recompacting typically increases considerably and may lead to alternative remediation solutions. These solutions can include overexcavation of some or all of the unstable material to be backfilled with either approved structural fill or geotextile and ABC Stone. Potential undercutting can be reduced if the site preparation work is performed during a period of dry weather and if construction traffic is kept to a minimum on prepared subgrades. We recommend that the contractor submit a unit rate cost for undercutting as part of the bidding process.

Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 5 feet of structures and pavements. General fill is material used to achieve grade outside of these areas.

Fill required to achieve design grade should meet the following material property requirements:

Soil Type ¹	USCS Classification or Material	Acceptable Location for Placement
Sand with Fines	SM, SC	All locations and elevations.
Sand / Gravel with less than 12% fines (silt and clay) ²	GW, GP, SW, SP, NCDOT ABC or No. 57	All locations and elevations.

1. Structural and general fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Sand/Gravel with less than 12 % fines (silt and clay) should not be used without adequate drainage installed as it may create perched water tables below the foundations, slabs, or pavements

On-site clayey soils (CL) are not recommended for use as structural fill due to their high fines content and moisture sensitivity relative to sandy soils available.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
Minimum Compaction Requirements ^{1,2,3}	95% of maximum 98% of maximum within 1 foot of pavement subgrade	92% of max.
Water Content Range ^{1, 3}	Within 2 percent of optimum moisture content	As required to achieve min. compaction requirements

1. Fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. It is not necessary to achieve 95% compaction on the existing ground prior to placing fill or beginning construction. However, the subgrade should be evaluated by the Geotechnical Engineer prior to placing fill or beginning construction.
3. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).
4. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility to be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the

backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 5 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 5 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with wet, unstable subgrades.

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps or alternate may be necessary to achieve the recommended depth of

overexcavation depending on groundwater conditions at the time of construction. The excavation should remain dewatered until backfilled with compacted fill.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure ^{1, 2}	2,000 psf
Required Bearing Stratum ³	Approved existing soil or structural fill
Minimum Foundation Dimensions	Columns: 24 inches Continuous: 16 inches Thickened: 12 inches
Sliding Resistance ⁴	0.35 ultimate coefficient of friction - granular material
Minimum Embedment below Finished Grade ⁵	12 inches
Estimated Total Settlement from Structural Loads ²	Less than about 1 inch
Estimated Differential Settlement ^{2, 6}	Less than 1/2 inch

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated. **The maximum net allowable bearing pressure may be increased by 1/3 for transient wind or seismic loads.**
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.

5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
6. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.

Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation when possible (e.g., $e < b/6$, where b is the foundation width). This is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the ASCE 7 and 2018 North Carolina State Building Code (NCSBC) basic load combinations.

Item	Description
Soil Moist Unit Weight	120 pcf
Soil Effective Unit Weight¹	45 pcf
Soil weight included in uplift resistance	Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface

1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. This is an essential part of the construction process. The Geotechnical Engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing should be performed to a depth of 3 to 5 feet below the bottom of foundation excavation and through any existing fill soils. Excessively soft, loose, or wet bearing soils should be over excavated to a depth recommended by the geotechnical engineer. The excavated soils should be replaced with structural fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric (Mirafi 140 N or equivalent). The need for the geotextile fabric with the crushed stone should be determined by the Geotechnical Engineer during construction based on

sloughing/caving soils and excavation observations. However, footings could bear directly on the soils after over excavation if approved by the Geotechnical Engineer.

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support¹	Suitable existing soils or new structural fill compacted in accordance with Earthwork section of this report.
Estimated Modulus of Subgrade Reaction ²	100 pounds per square inch per inch (psi/in) for point loads
Stone Base Course	4 inches of crushed aggregate base course (NCDOT ABC)

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation. . For turn down/thickened slabs, the transition should be designed by the structural engineer to help prevent the cracking associated with the differential movements between the slab and thickened/turn down elements.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base stone and concrete and corrective action will be required to repair the damaged areas.

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

Pavements

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in [Project Description](#) and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this

section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

We have assumed that traffic loads at the site will be produced primarily by delivery and garbage trucks in the medium duty areas and by passenger cars and light delivery vehicles for the light duty areas. Two pavement section alternatives have been provided. The light-duty pavement sections are for car parking areas only. Medium-duty pavement sections should be used for concentrated car traffic (drive lanes / entrance drives) and garbage/delivery truck traffic areas. A third section for Heavy duty pavements are for areas subject to concentrated and repetitive loading conditions, i.e. dumpster pads and ingress/egress aprons, or in areas where vehicles will turn at low speeds.

A California Bearing Ratio (CBR) of 3 was used for the subgrade for the asphaltic concrete (AC) pavement designs. The value was empirically derived based upon our experience with the sandy subgrade soils and our expectation of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**. A minimum pavement section thickness was also included in the design for future maintenance.

Pavement Section Thicknesses

The following table provides our opinion of minimum thickness for AC sections:

Asphaltic Concrete Design

Layer	Asphaltic Concrete Design		
	NCDOT Grading ¹	Automobile Areas (Light Duty)	Main Drives and Truck Access Areas (Medium Duty)
AC Surface	S9.5B	3 ²	1.5
AC Intermediate	I19.0C	--	2.5
Aggregate Base	ABC	6	8

1. All materials should meet the current North Carolina Department of Transportation Standard Specifications
2. Placed in two equal lifts.
3. See **Project Description** for more specifics regarding traffic assumptions.

The following table provides our estimated minimum thickness of PCC pavements.

Portland Cement Concrete Design

Layer	Specification ¹	Thickness (inches)		
		Automobile Areas (Light Duty)	Main Drives and Truck Access Areas (Medium Duty)	Heavy Repetitive Loading ²
PCC ³	4,000 psi		5	7
Aggregate Base	NCDOT ABC ³		4 ¹	4

1. Crushed Aggregate Base Course is recommended for construction purposes. Concrete could be placed directly on an approved subgrade. However, stormwater can quickly degrade exposed subgrades without the crushed aggregate base course leading to additional subgrade repair.
2. See **Project Description** for more specifics regarding traffic classifications.
3. All materials should meet the current North Carolina Department of Transportation (NCDOT) Standard Specifications.
4. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g. dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.

For subgrade instability that could develop due to the weather, we recommend that contingencies be placed in the budget for stabilization of the subgrade in planned pavement areas using a geosynthetic fabric or geogrid and additional ABC stone. The geosynthetic or geogrid could be left off corridors/easements for deeper utility lines for ease of construction.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles.

Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer. PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its “green” state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. Islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils are particular areas of concern. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the stormwater collection system, longitudinal subdrains, or other suitable outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic upkeep should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Pavement care consists of both localized (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Additional engineering consultation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and

Geotechnical Engineering Report

Pitt Community College – Welding Building | Winterville, North Carolina

May 3, 2023 | Terracon Project No. 72235023



recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Geotechnical Engineering Report

Pitt Community College – Welding Building | Winterville, North Carolina
May 3, 2023 | Terracon Project No. 72235023

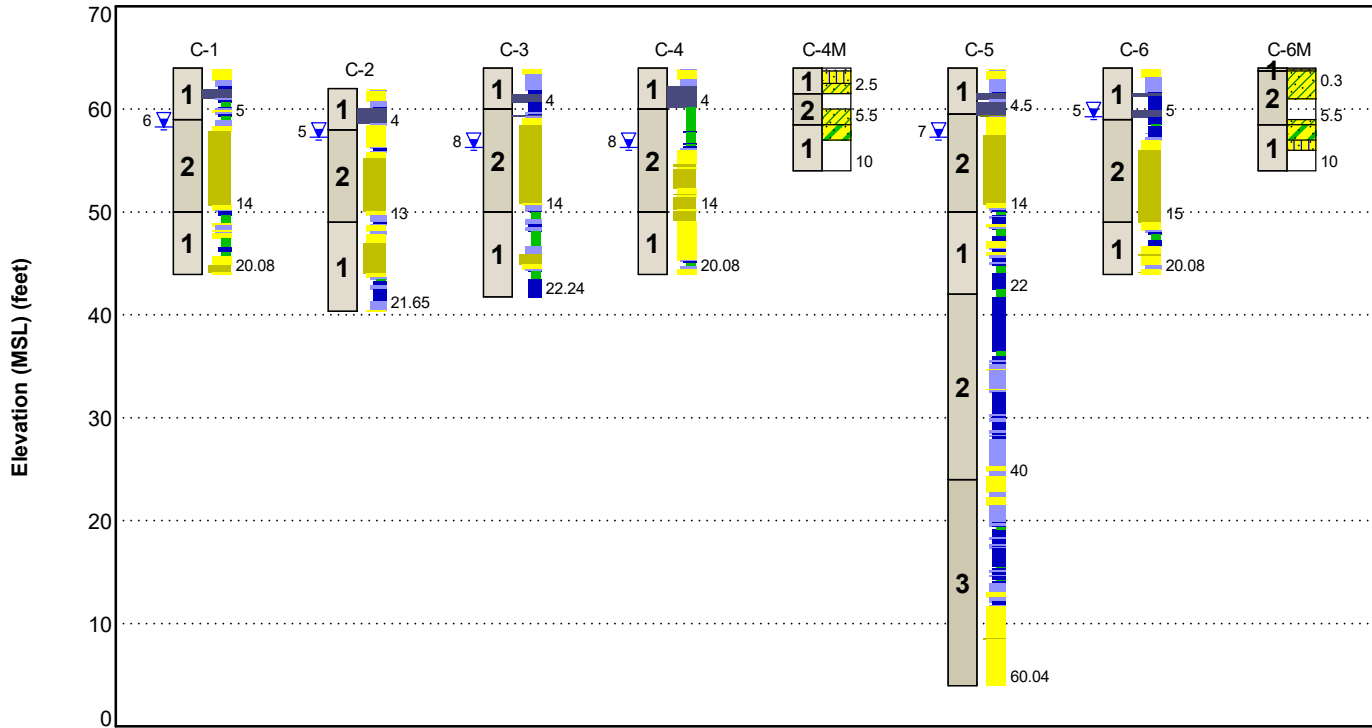


Figures

Contents:

GeoModel (2 pages)

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Looser Sand and Clay	Loose to medium dense sand and soft to medium stiff clay
2	Sand and Clay	Loose to medium dense sand and medium stiff to stiff clay
3	Denser Sand	Medium dense to dense sand

LEGEND

- Topsoil
- Clayey Sand
- Silty Sand
- Sandy Lean Clay

Soil Behavior Type (SBT)

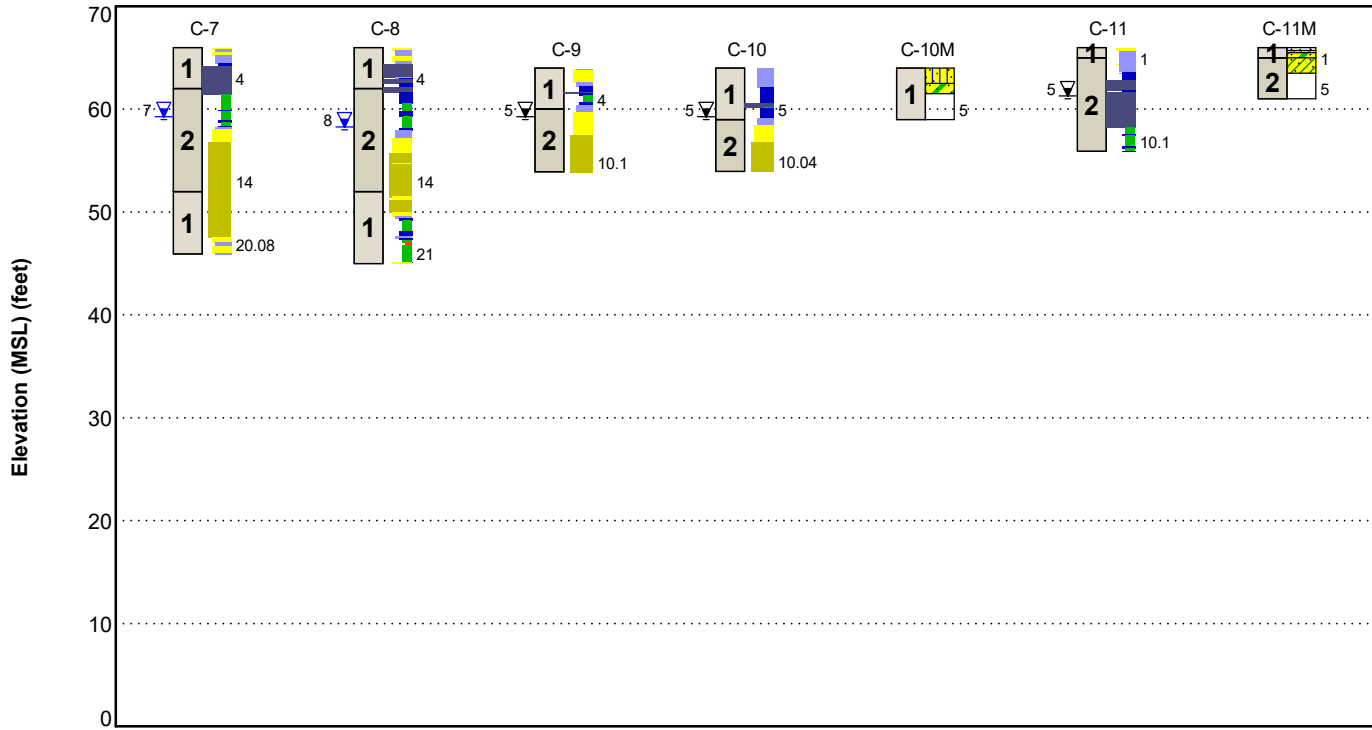
- | | | |
|---|--|------------------------------------|
| 1 Sensitive, fine grained | 2 Organic soils - clay | 3 Clay - silty clay to clay |
| 4 Silt mixtures - clayey silt to silty clay | 5 Sand mixtures - silty sand to sandy silt | 6 Sands - clean sand to silty sand |
| 7 Gravelly sand to dense sand | 8 Very stiff sand to clayey sand | 9 Very stiff fine grained |

- CPT Assumed Water Depth
- CPT Water Depth

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

GeoModel



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Model Layer	Layer Name	General Description
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LEGEND

- Silty Sand
- Sandy Lean Clay
- Clayey Sand
- Topsoil

Soil Behavior Type (SBT)

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Geotechnical Engineering Report

Pitt Community College – Welding Building | Winterville, North Carolina

May 3, 2023 | Terracon Project No. 72235023



Attachments

Exploration and Testing Procedures

Field Exploration

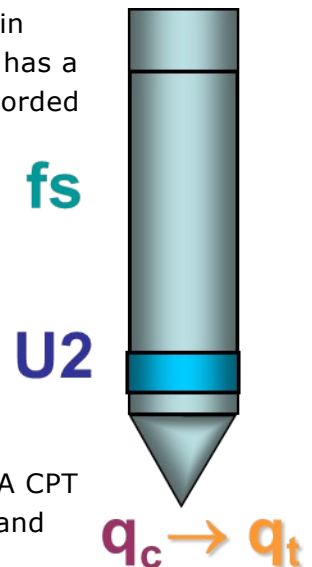
Number of CPT Soundings	Approximate CPT Sounding Depths (feet)	Location
7	20	Perimeter of Building area
1	60	Center of Building area
3	10	Parking/driveway area

CPT Sounding Layout and Elevations: JKF Architecture, P.C. provided the requested CPT sounding layout, Terracon made minor modifications and located points in the field using handheld GPS equipment (estimated horizontal accuracy of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were obtained by interpolation from the Pitt County GIS website. If elevations and a more precise boring layout are desired, we recommend borings be surveyed.

Subsurface Exploration Procedures: The subsurface exploration was performed by a track mounted power drilling rig utilizing direct push, cone penetration testing (CPT) to advance into the subsurface.

Cone Penetration Testing (CPT): The CPT soundings were conducted in general accordance with ASTM D 5778. The cone used in the soundings has a tip area of 10 cm² and a sleeve area of 150 cm². The CPT soundings recorded tip resistance and sleeve friction measurements to assist in determining pertinent index and engineering properties of the site soils. The ratio of the sleeve friction to tip resistance is then used to aid in assessing the soil types through which the tip is advanced. CPT sounding logs are presented in the appendix.

Please note that the CPT logs provide the soil behavior type, not necessarily the soil classification. Soil Behavior Type is calculated based on empirical correlations which use the three fundamental penetrometer measurements (i.e., tip resistance, sleeve friction, and pore pressure). A CPT may define a soil based on its behavior as one type, while its grain size and plasticity (the traditional basis for soil classification) may define it as a different type.



We also observed the test holes at the completion of testing for the presence of groundwater. The groundwater levels are shown on the attached sounding logs.

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May 3, 2023 | Terracon Project No. 72235023



Macrocore soil samples were obtained using the CPT rig in the upper 10 feet at C-4, C-6 and the upper 5 feet at C-10 and C-11. The samples were placed appropriate containers, taken to our soil laboratory for testing, and classified by a Geotechnical Engineer.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Atterberg Limits
- Grain Size Analysis

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Photography Log

Site photographs taken March 31, 2023



Site facing north near location C-4



Site facing south near location C-10

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Site Location and Exploration Plans

Contents:

Site Vicinity Plan
Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

Site Vicinity Plan

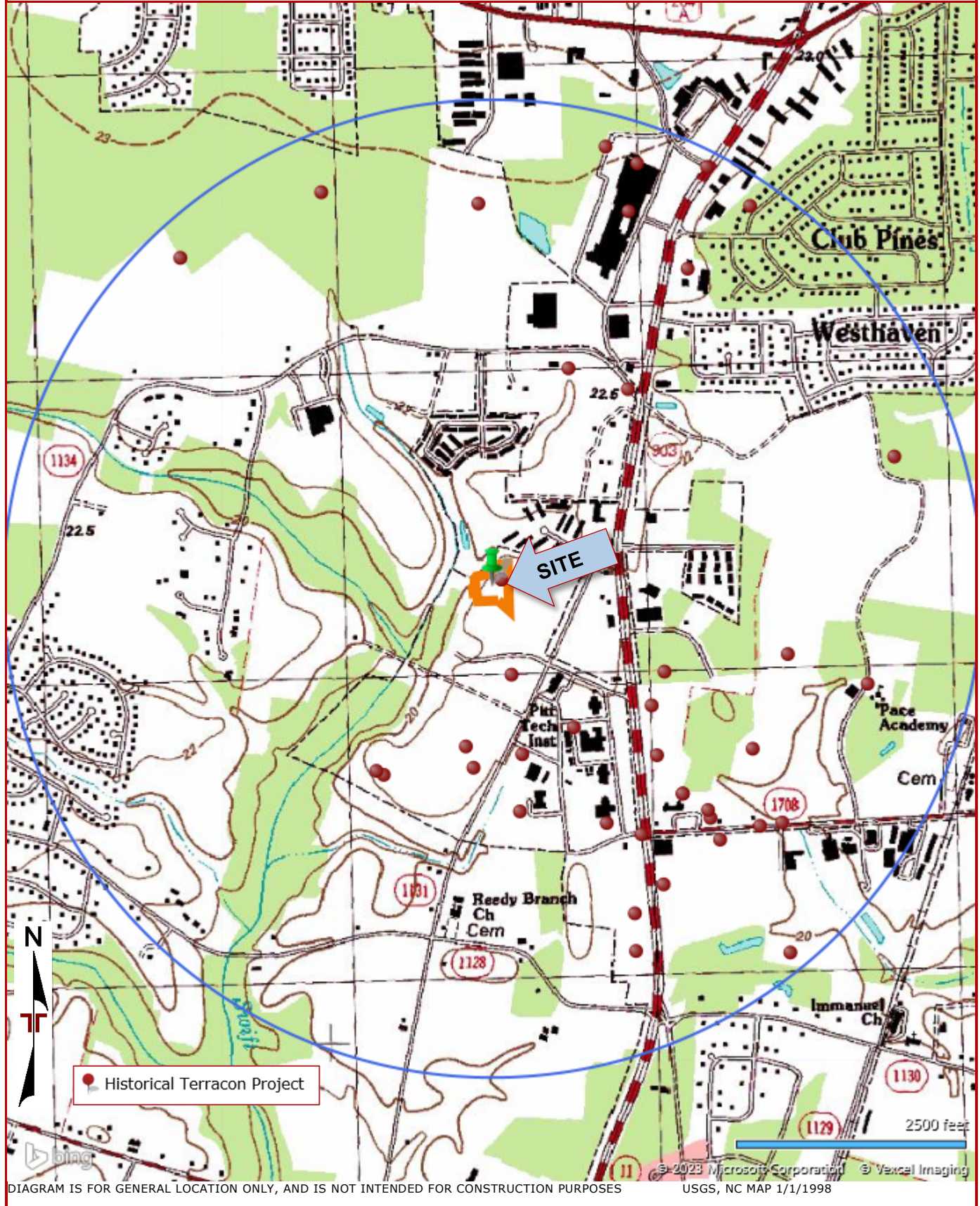


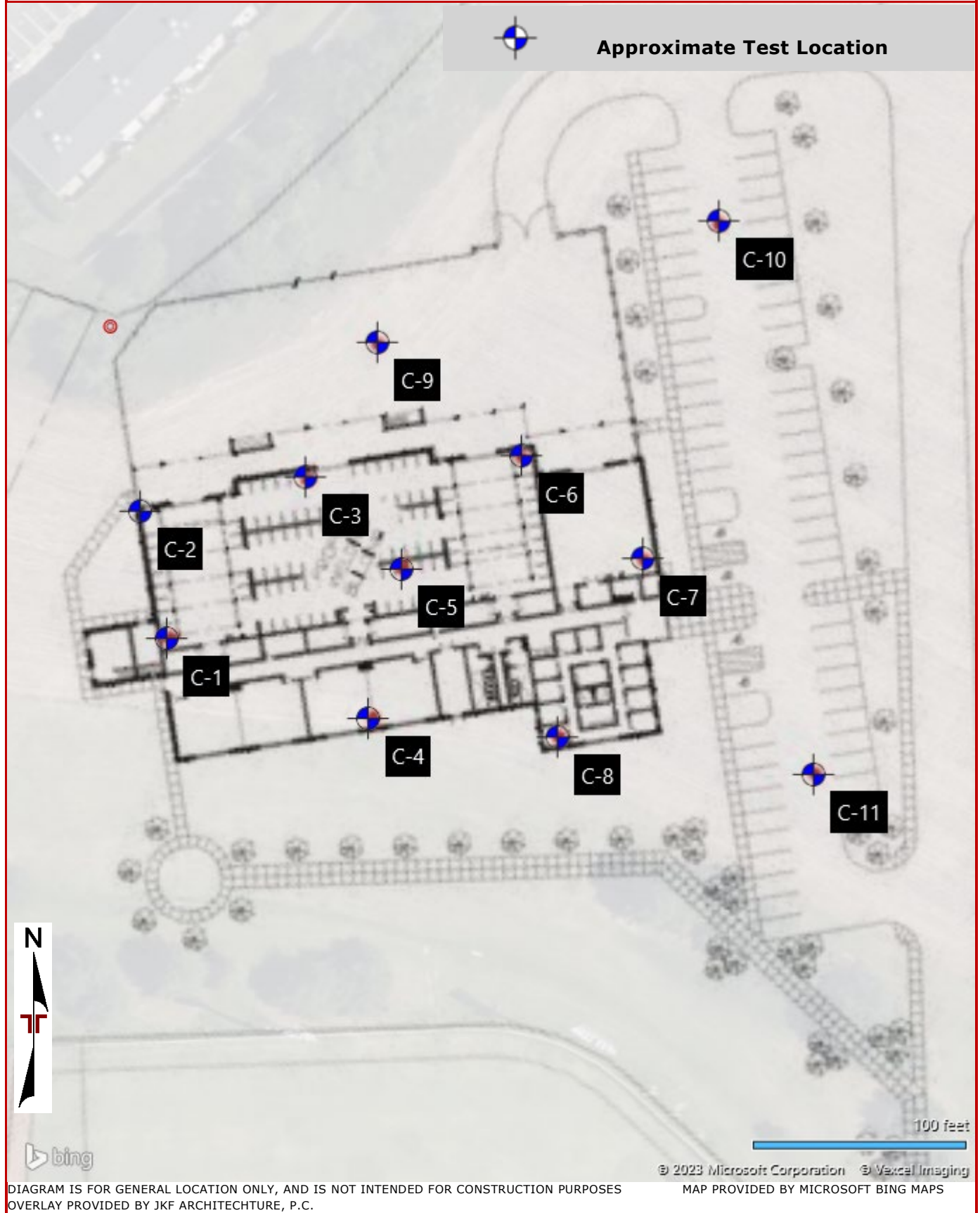
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

USGS, NC MAP 1/1/1998

Site Location Plan



Exploration Plan



Exploration and Laboratory Results

Contents:

CPT Sounding Logs (C-1 through C-11)

Boring Logs - MacroCore (C-4M, C-6M, C-10M, and C-11M)

Atterberg Limits

Grain Size Distribution

Note: All attachments are one page unless noted above.

CPT Sounding ID C-1



314 Beacon Dr
 Winterville, NC

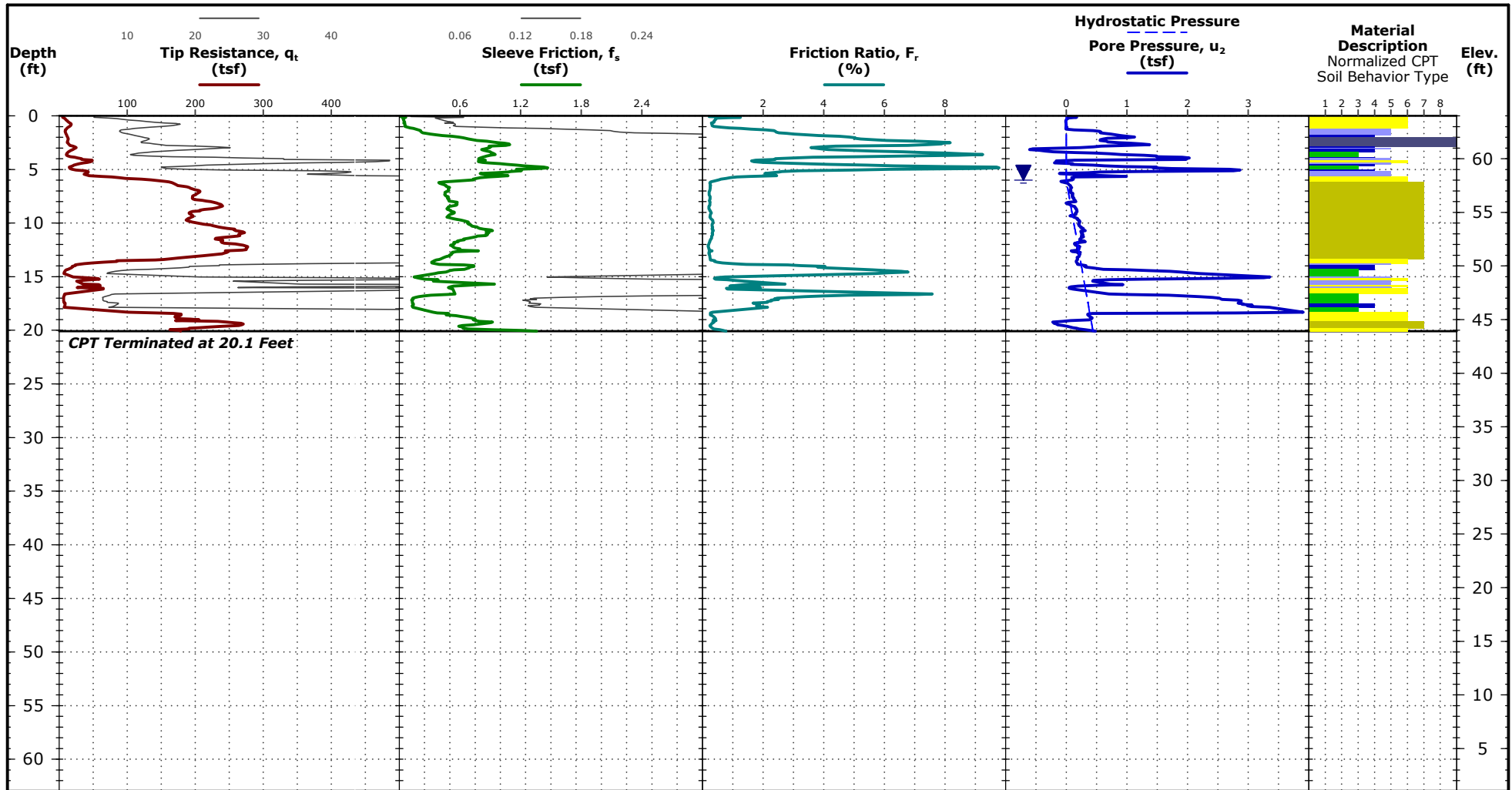
Latitude: 35.5551° Longitude: -77.4114°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 7 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 6 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-2



314 Beacon Dr
 Winterville, NC

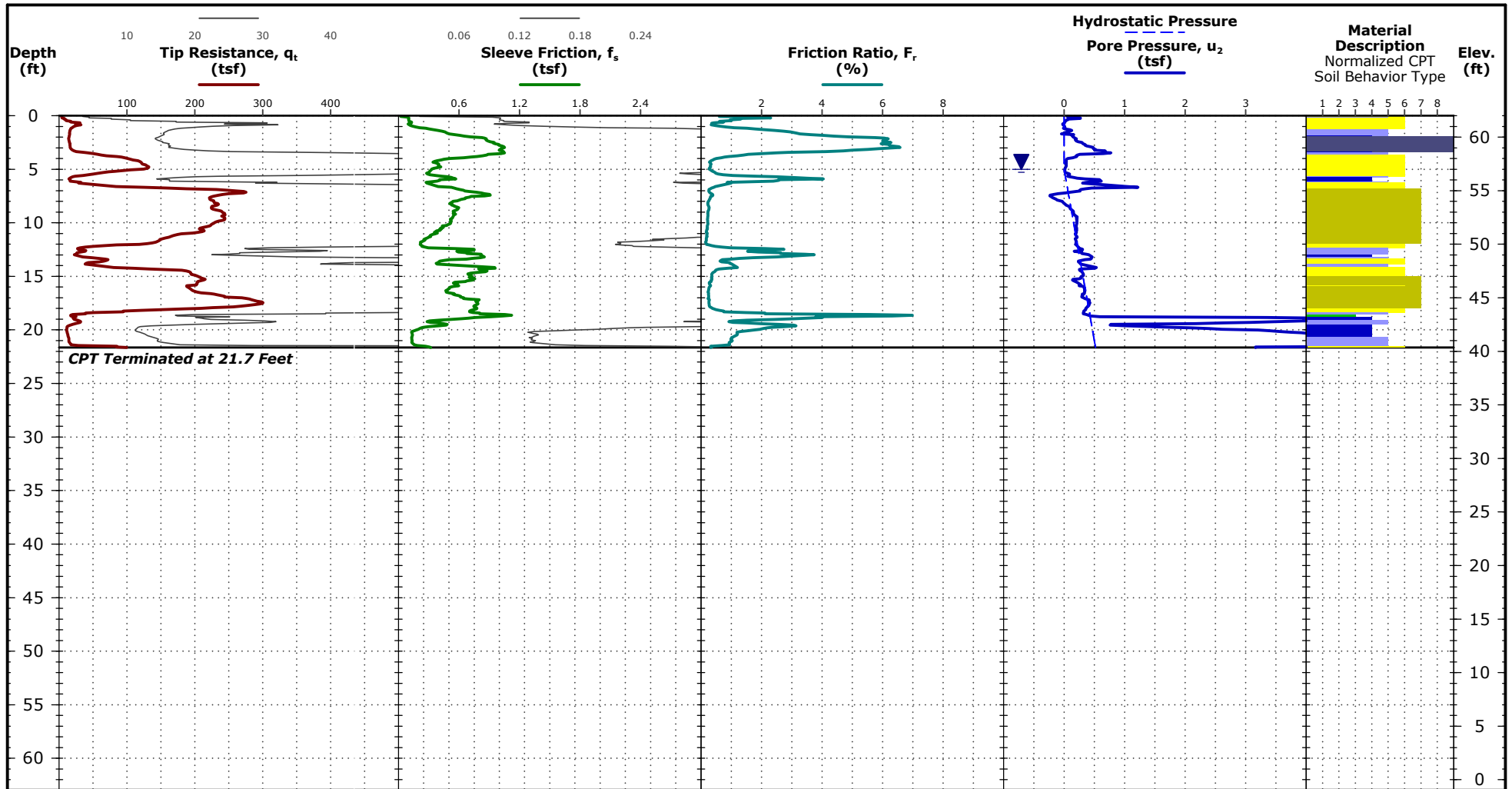
Latitude: 35.5552° Longitude: -77.4114°

Elevation: 62 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 6 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U₂ pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 5 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-3



314 Beacon Dr
 Winterville, NC

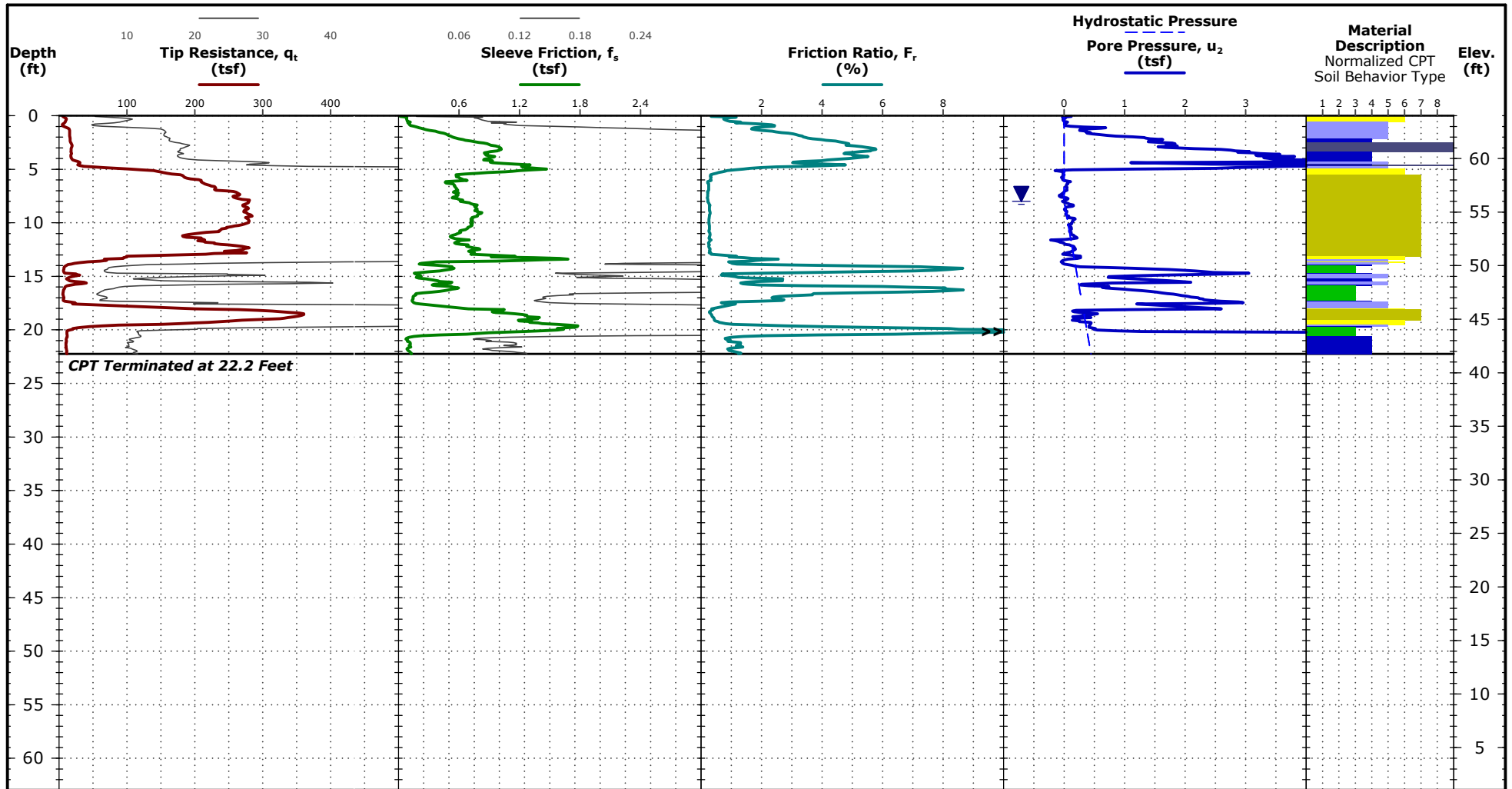
Latitude: 35.5553° Longitude: -77.4112°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 9 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U₂ pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 8 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-4



314 Beacon Dr
 Winterville, NC

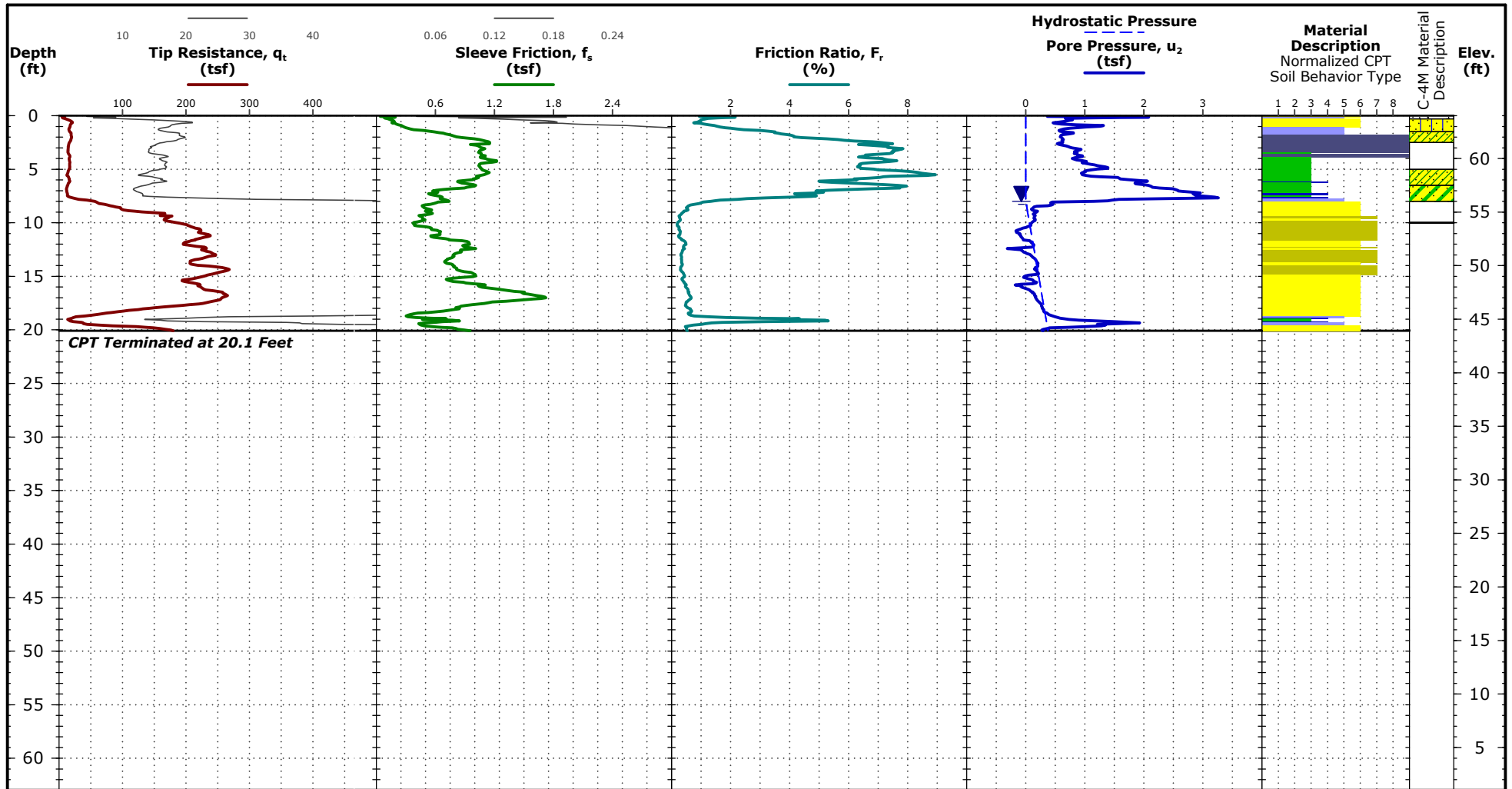
Latitude: 35.5550° Longitude: -77.4111°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 See C-4M for the adjacent test's full details.
 Cave = 8 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 u_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 8 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-5



314 Beacon Dr
 Winterville, NC

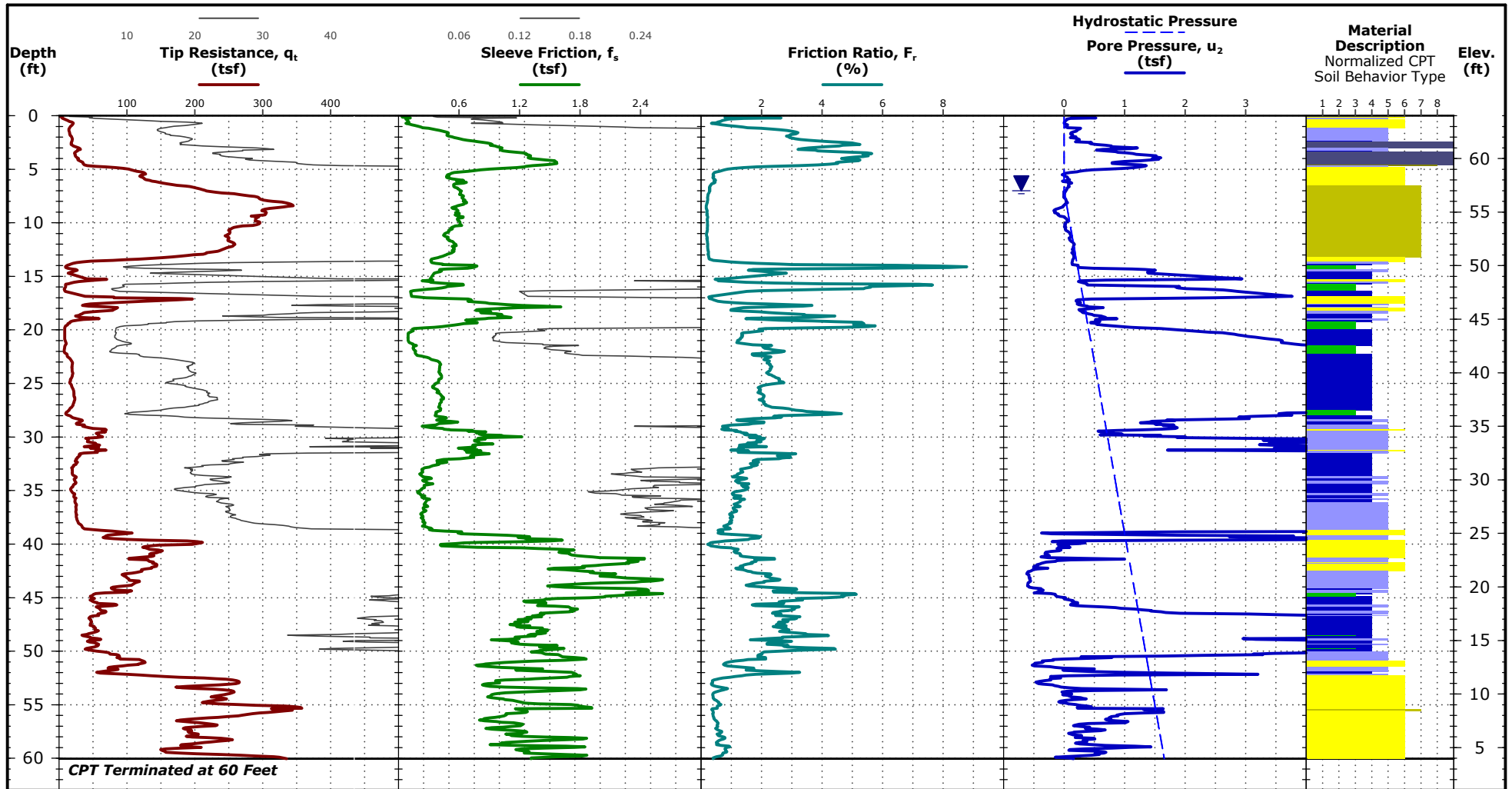
Latitude: 35.5551° Longitude: -77.4110°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 9 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 7 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-6



314 Beacon Dr
 Winterville, NC

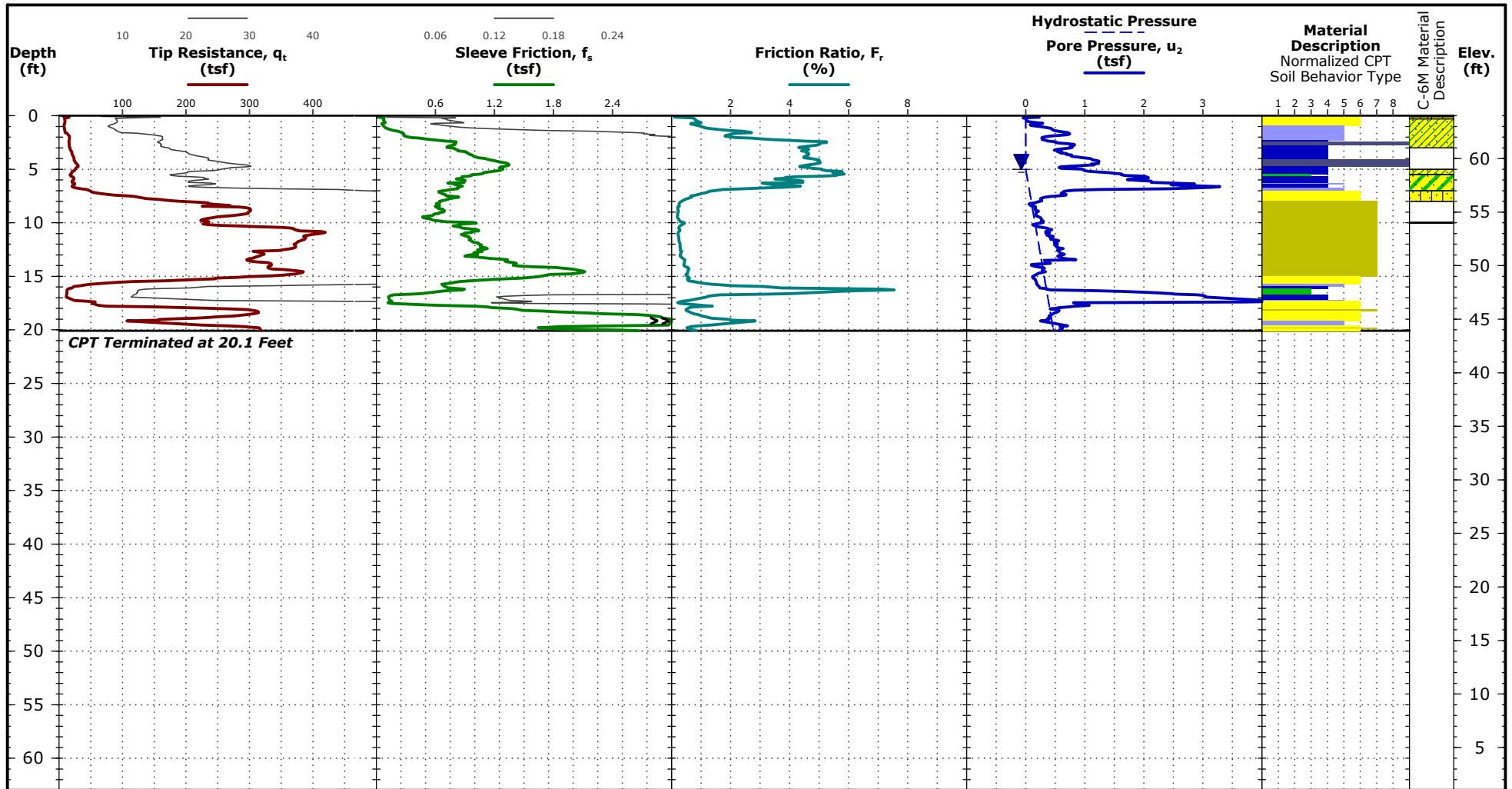
Latitude: 35.5553° Longitude: -77.4108°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/11/2023

CPT Completed: 4/11/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 See C-6M for the adjacent test's full details.
 Cave = 7 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 5 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-7



314 Beacon Dr
 Winterville, NC

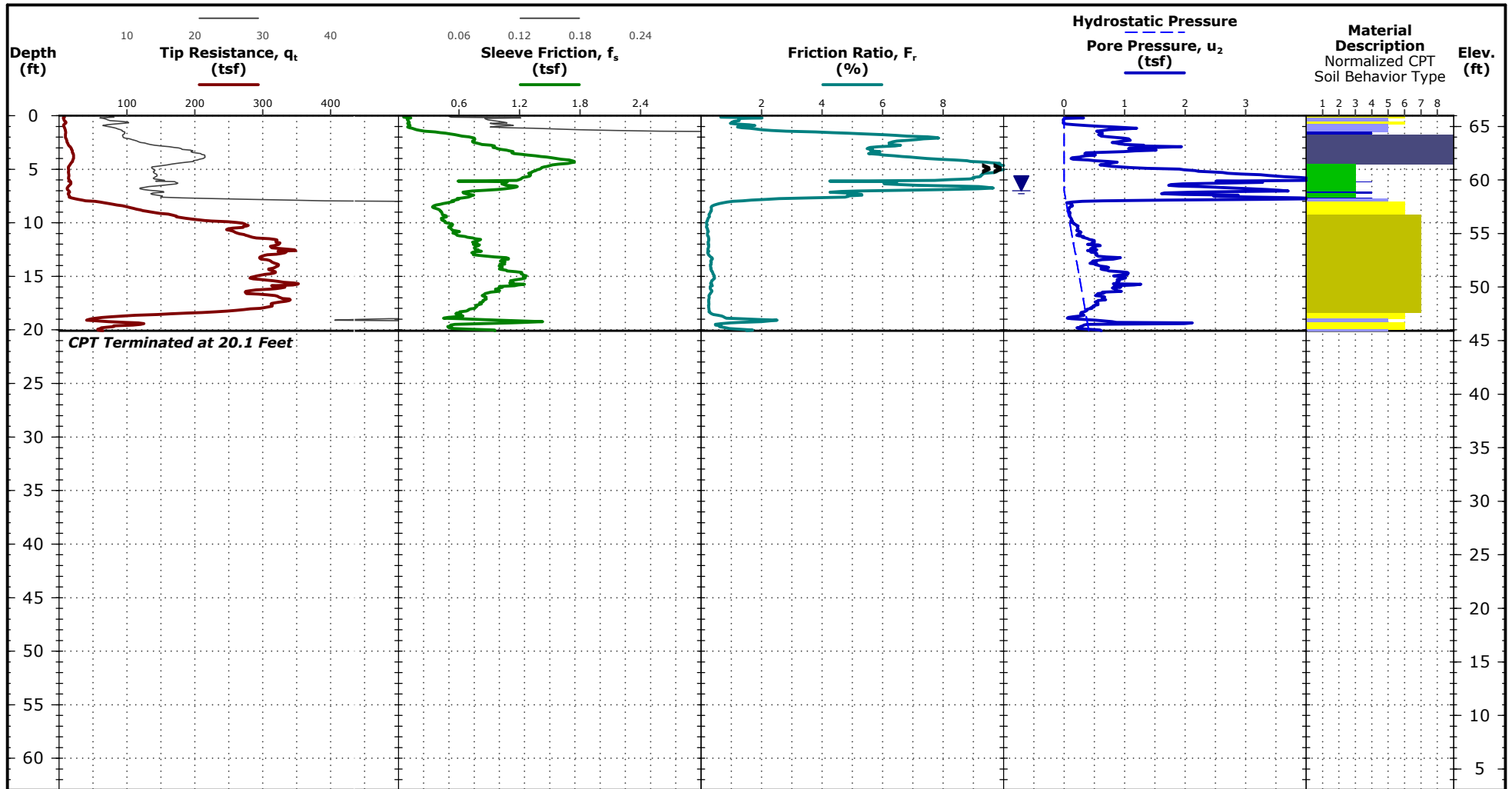
Latitude: 35.5552° Longitude: -77.4106°

Elevation: 66 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/11/2023

CPT Completed: 4/11/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 9 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 7 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-8



314 Beacon Dr
 Winterville, NC

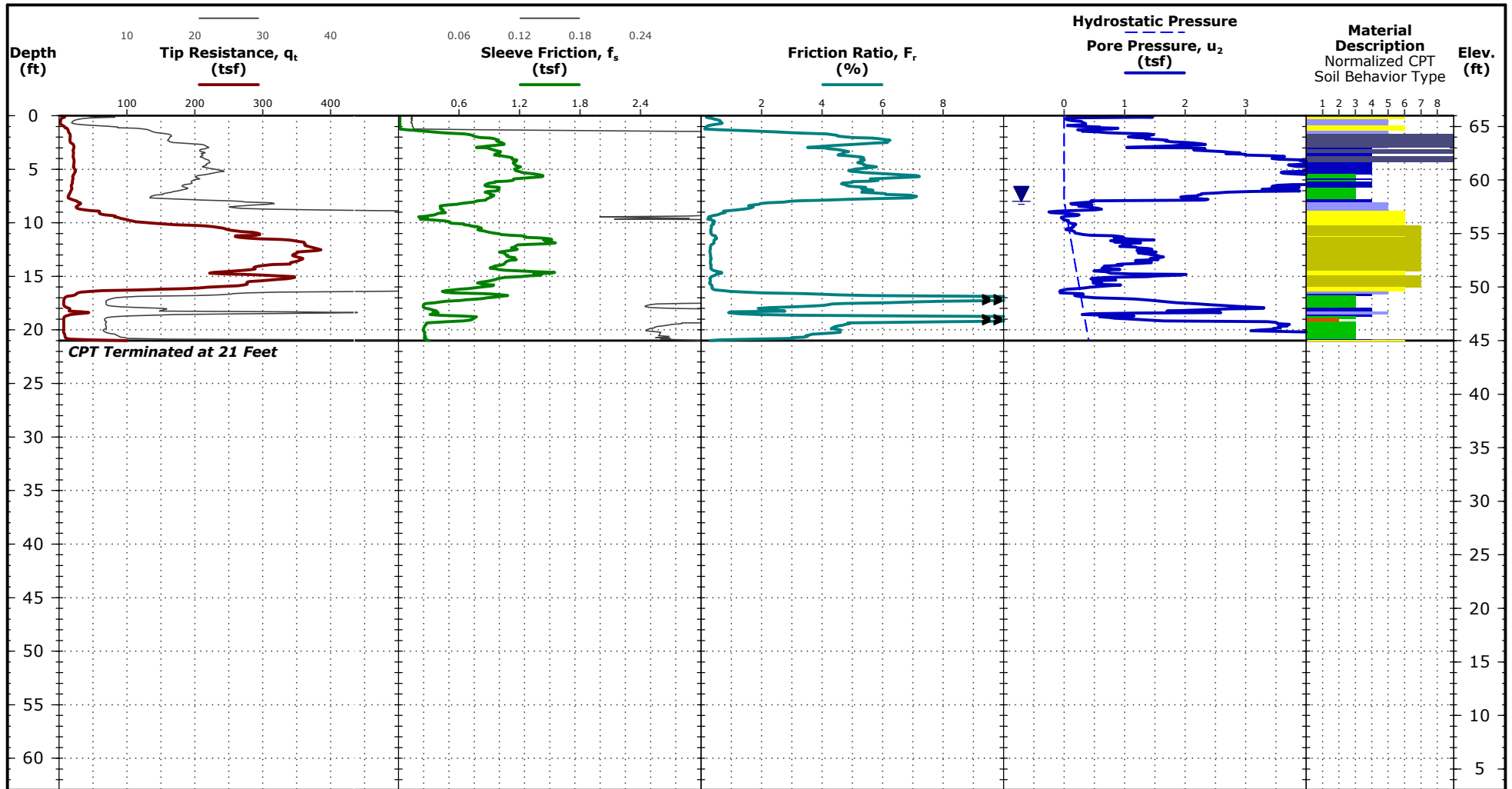
Latitude: 35.5549° Longitude: -77.4108°

Elevation: 66 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 9 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 8 ft measured water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-9



314 Beacon Dr
 Winterville, NC

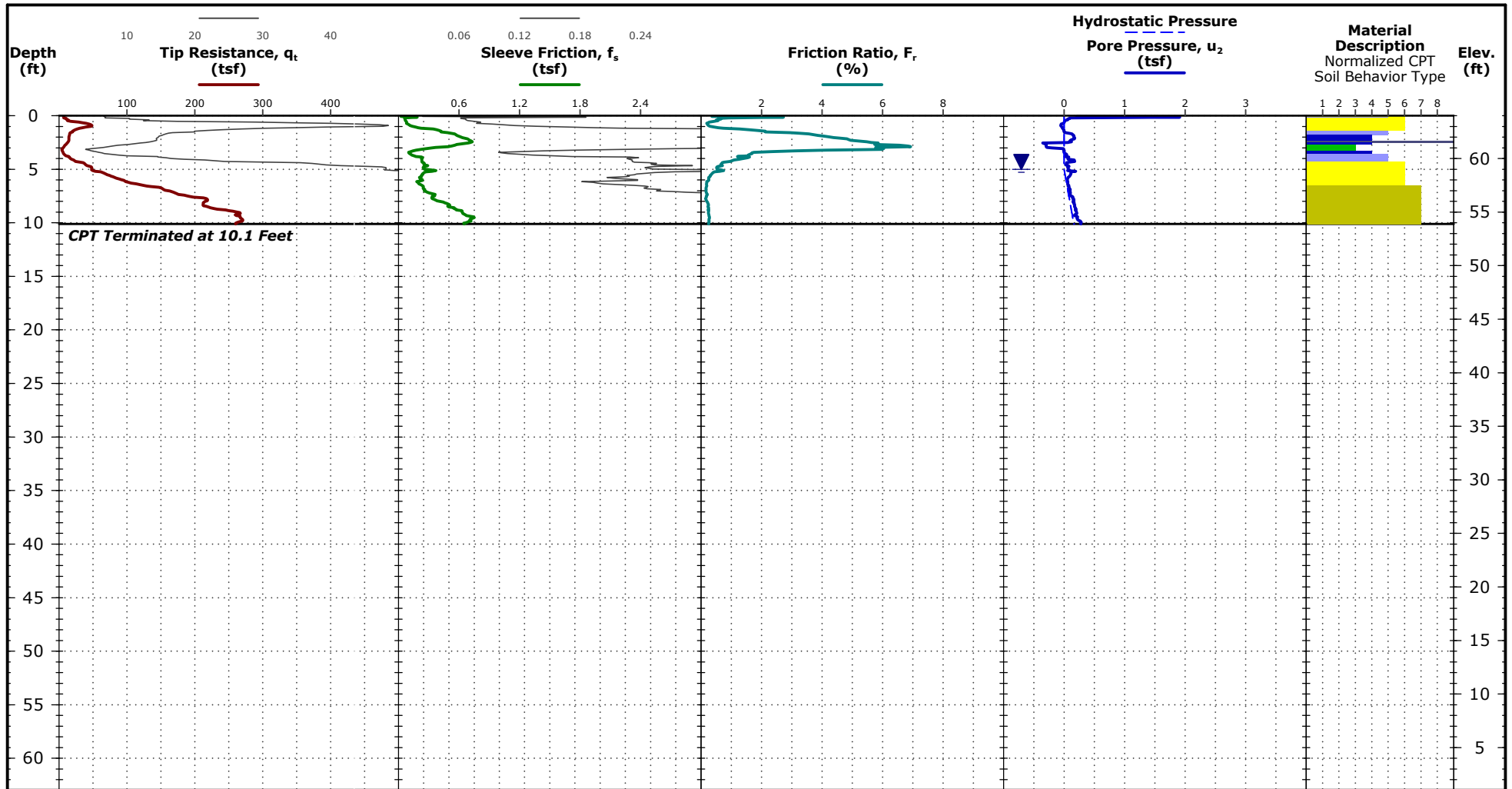
Latitude: 35.5554° Longitude: -77.4111°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/11/2023

CPT Completed: 4/11/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 Cave = 2 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U₂ pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 5 ft estimated water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-10



314 Beacon Dr
 Winterville, NC

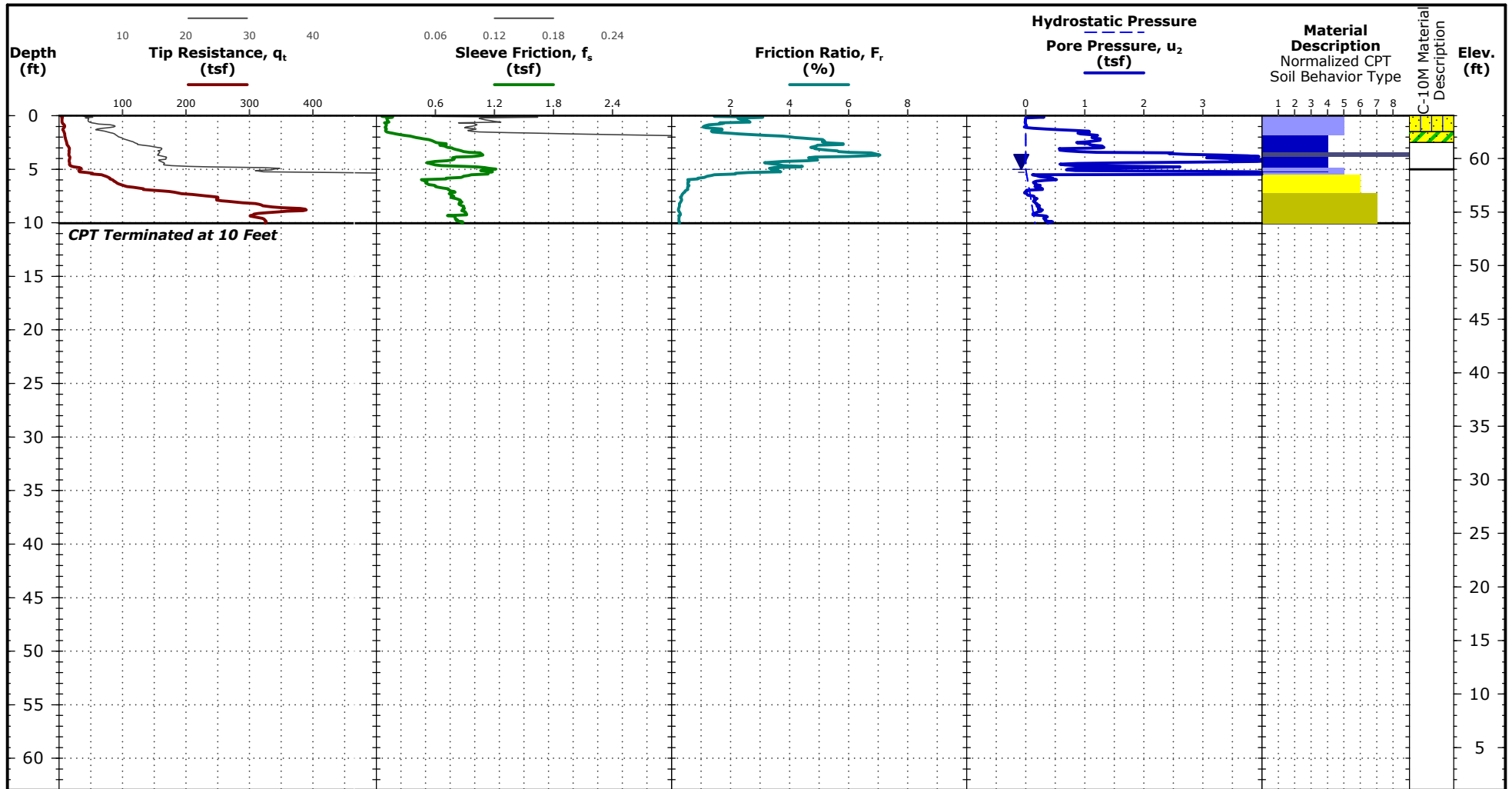
Latitude: 35.5556° Longitude: -77.4105°

Elevation: 64 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/11/2023

CPT Completed: 4/11/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 See C-10M for the adjacent test's full details.
 Cave = 3 feet

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 u_2 pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 5 ft estimated water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

CPT Sounding ID C-11



314 Beacon Dr
 Winterville, NC

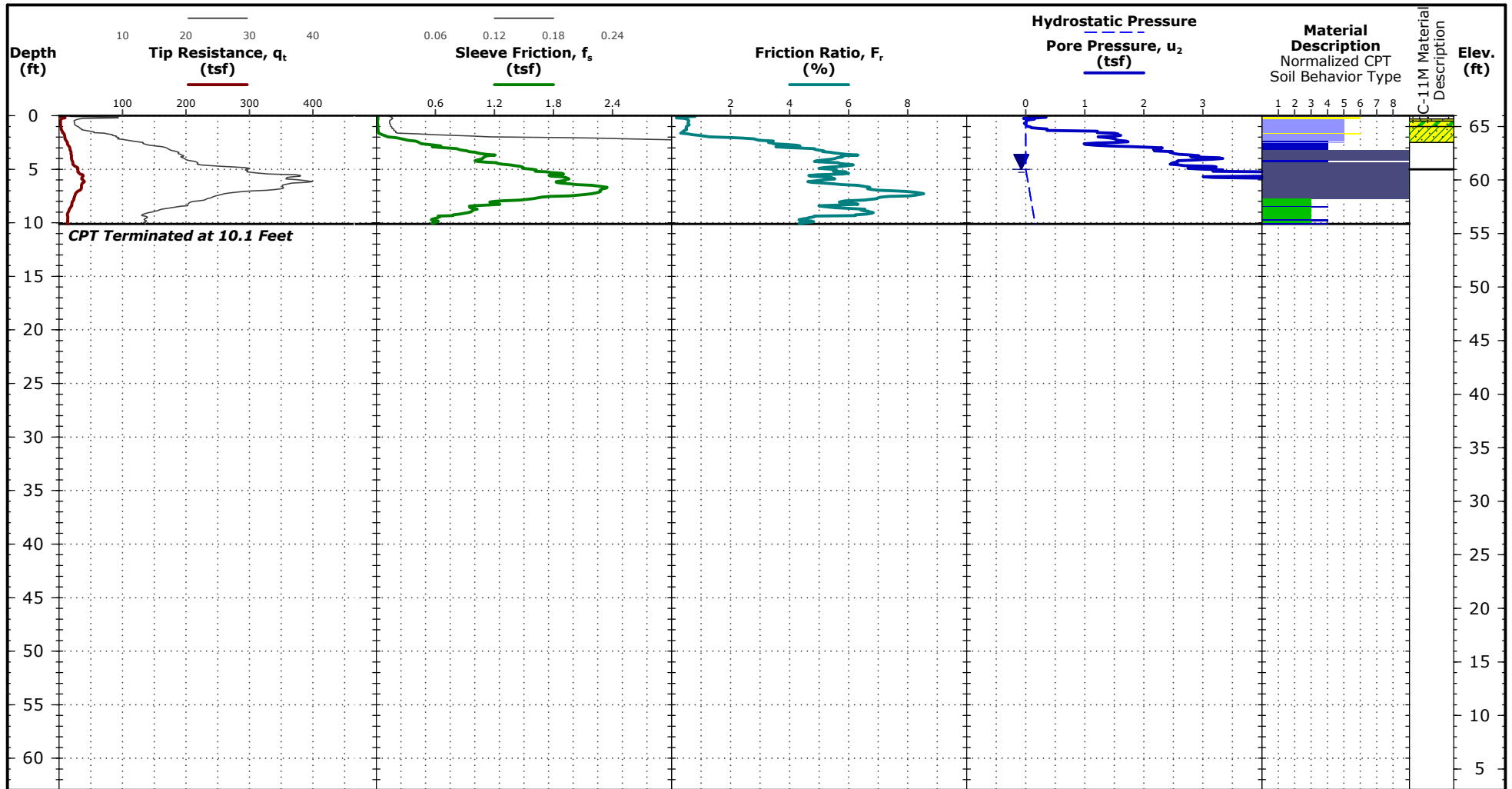
Latitude: 35.5549° Longitude: -77.4104°

Elevation: 66 (ft)

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.

CPT Started: 4/10/2023

CPT Completed: 4/10/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Test Location: See [Exploration Plan](#)
 See C-11M for the adjacent test's full details.
 Cave = 1 foot

CPT Equipment

CPT Rig: 7822DT Geoprobe
 Operator: T. Whitehead
 Auger anchors used as reaction force
 CPT sensor calibration reports available upon request
 Probe No. 5632 with net area ratio of 0.85
 U₂ pore pressure transducer location
 Manufactured by Nova- Calibrated 2/17/2022
 Tip and sleeve areas of 15 cm² and 225 cm²
 Ring friction reducer with O.D. of 2 in

Water Level Observation

▼ 5 ft estimated water depth
 (used in normalizations and correlations)

Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

Boring Log No. C-4M

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5550° Longitude: -77.4111°	Depth (Ft.)	Elevation: 64 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
										LL-PL-PI	Percent Fines
		TOPSOIL , 3 inches	0.3	63.7							
1		SILTY SAND (SM) , brown and dark gray	1.5	62.5					18.8		
		SANDY LEAN CLAY (CL) , light gray, orange and red	2.5	61.5					21.4		
2		No recovery	4.0	60							
		SANDY LEAN CLAY (CL) , light gray, orange and red	5.5	58.5	5				21.9	40-18-22	65
1		CLAYEY SAND (SC) , light gray, orange and red	7.0	57							
		No recovery	10.0	54	10						
Boring Terminated at 10 Feet											

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.
 Cave = 9 feet
 See CPT log for GW elevations.

Water Level Observations

Cave in

Advancement Method
 Direct Push

Abandonment Method
 Boring backfilled with bentonite chips upon completion.

Drill Rig
 7822DT Geoprobe

Driller
 T. Whitehead

Logged by
 L. West

Boring Started
 04-10-2023

Boring Completed
 04-10-2023

Boring Log No. C-6M

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5553° Longitude: -77.4108°	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1		Depth (Ft.) Elevation: 64 (Ft.) +/-							
		0.1 TOPSOIL , 1 inch	63.9						
		0.3 SILTY SAND (SM) , brown	63.7						
		SANDY LEAN CLAY (CL) , brownish orange to orange, light gray and red							
		3.0	61						
		No recovery							
		5.0	59	5					
		SANDY LEAN CLAY (CL) , light gray, orange and red							
		5.5 CLAYEY SAND (SC) , light gray, orange and red	58.5						
2		7.0 SILTY SAND (SM) , orange and light tan	57						
		8.0 No recovery	56						
		10.0	54	10					
		Boring Terminated at 10 Feet							

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.
 Cave = 7 feet
 See CPT log for GW elevations.

Water Level Observations

Cave in

Advancement Method
 Direct Push

Abandonment Method
 Boring backfilled with bentonite chips upon completion.

Drill Rig
 7822DT Geoprobe

Driller
 T. Whitehead

Logged by
 L. West

Boring Started
 04-11-2023

Boring Completed
 04-11-2023

Boring Log No. C-10M

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5556° Longitude: -77.4105° Depth (Ft.) Elevation: 64 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
								LL-PL-PI	Percent Fines
1	0.1	TOPSOIL , 1 inch	63.9				22.3		
	1.5	SILTY SAND (SM) , dark grayish brown	62.5						
	2.5	CLAYEY SAND (SC) , light gray and orange	61.5						
	5.0	No recovery	59	5	5				
		Boring Terminated at 5 Feet							

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.
 Cave = 3 feet
 See CPT log for GW elevations.

Water Level Observations

Cave in

Advancement Method

Direct Push

Abandonment Method

Boring backfilled with bentonite chips upon completion.

Drill Rig
7822DT Geoprobe

Driller
T. Whitehead

Logged by
L. West

Boring Started
04-11-2023

Boring Completed
04-11-2023

Boring Log No. C-11M

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 35.5549° Longitude: -77.4104°	Depth (Ft.)	Elevation: 66 (Ft.) +/-	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits	
									LL-PL-PI	Percent Fines
		TOPSOIL , 3 inches	0.3	65.7						
1		SILTY SAND (SM) , dark grayish brown	0.5	65.5						
		CLAYEY SAND (SC) , orange and gray	1.0	65				19.9	31-17-14	45
2		SANDY LEAN CLAY (CL) , light gray, orange and red	2.5	63.5						
		No recovery	5.0	61						
Boring Terminated at 5 Feet										

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).
 See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Elevation Reference: Approximate elevations were obtained from the Pitt County NC OPIS website.
 Cave = 1 foot
 See CPT log for GW elevations.

Water Level Observations

Cave in

Advancement Method
 Direct Push

Abandonment Method
 Boring backfilled with bentonite chips upon completion.

Drill Rig
 7822DT Geoprobe

Driller
 T. Whitehead

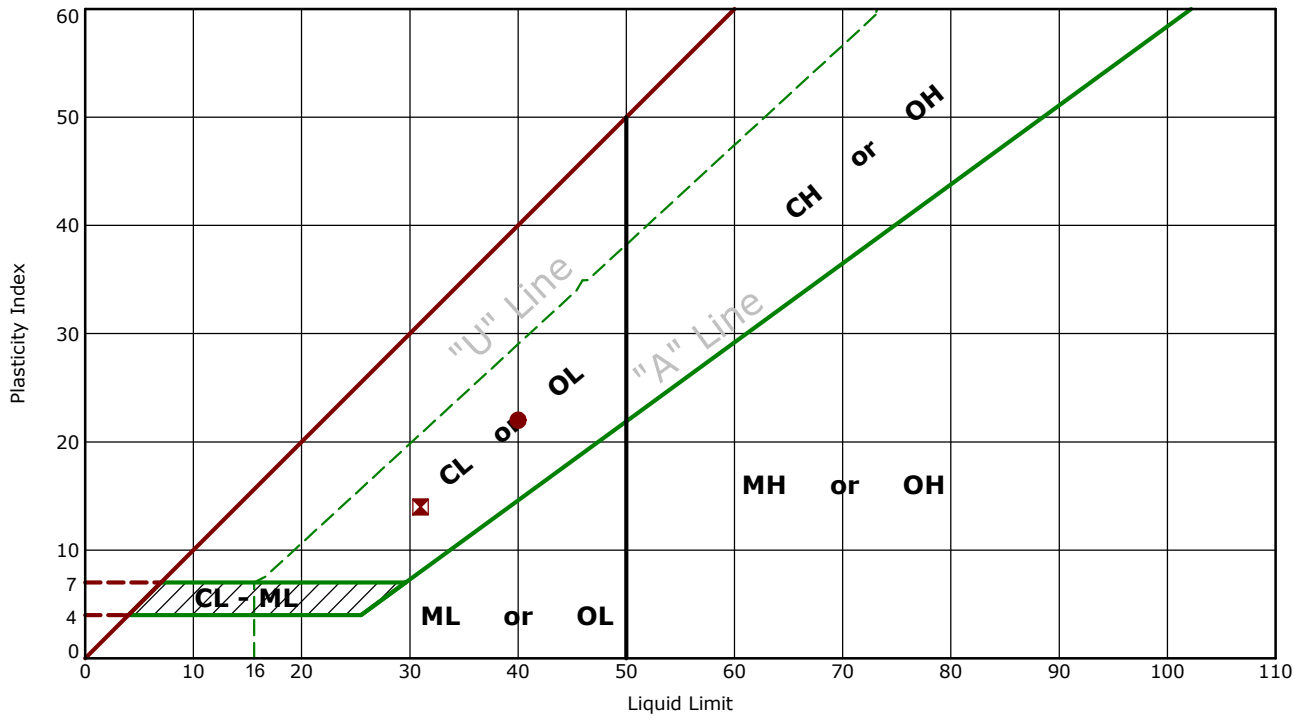
Logged by
 L. West

Boring Started
 04-10-2023

Boring Completed
 04-10-2023

Atterberg Limit Results

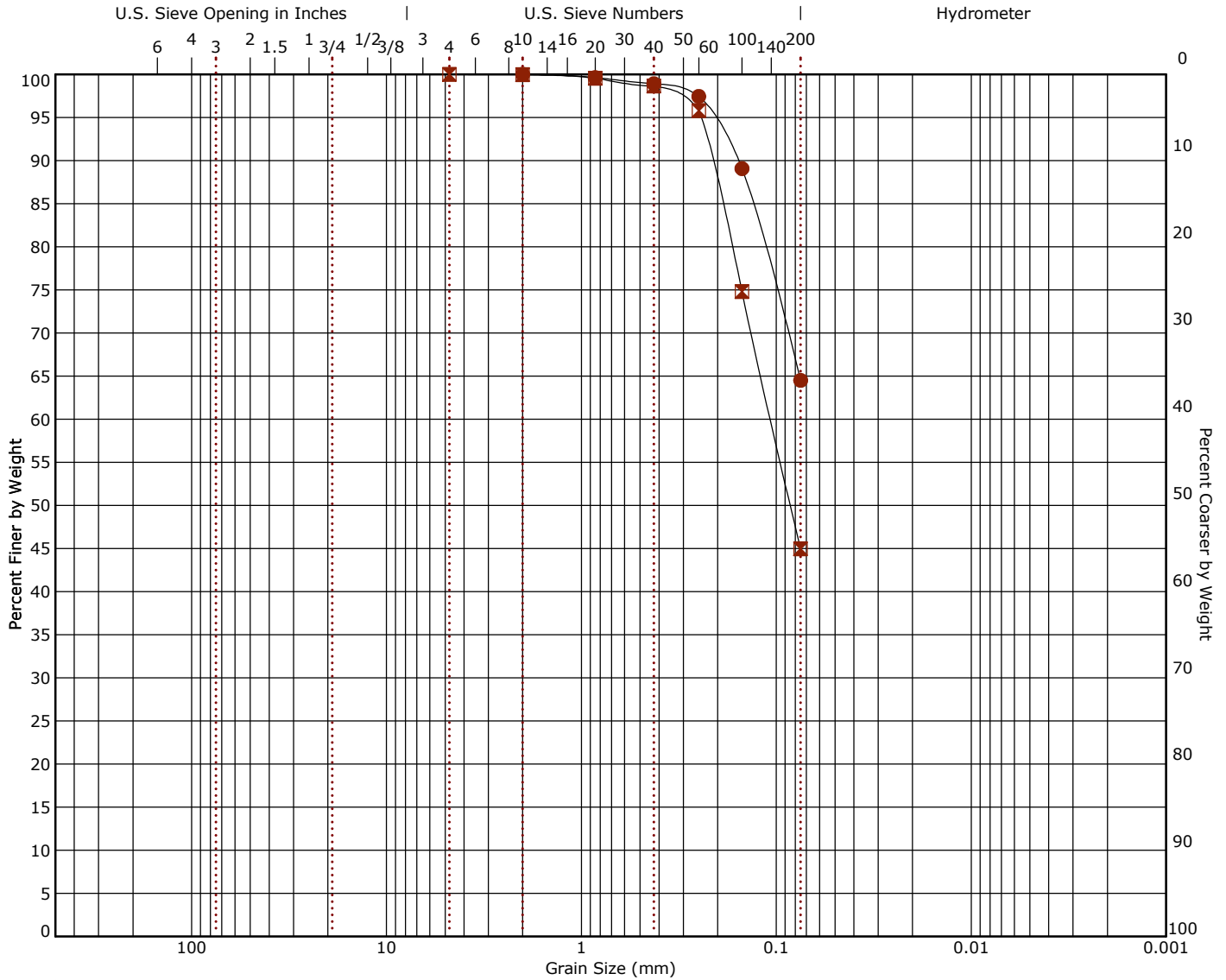
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	C-4M	5.5	40	18	22	64.5	CL	SANDY LEAN CLAY
⊠	C-11M	1	31	17	14	45.0	SC	CLAYEY SAND

Grain Size Distribution

ASTM D422 / ASTM C136



	Cobbles	Gravel		Sand			Silt or Clay		USCS
		coarse	fine	coarse	medium	fine	% Silt	% Clay	
● C-4M						35.5	64.5		CL
✘ C-11M						55.0	45.0		SC

Description	●		✘		Sieve % Finer		Grain Size				
● SANDY LEAN CLAY	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer		●	✘		
✘ CLAYEY SAND	#10	100.0	#4	100.0							
	#20	99.63	#10	99.96						D ₆₀	0.106
	#40	98.91	#20	99.56						D ₃₀	
	#60	97.44	#40	98.66						D ₁₀	
	#100	89.07	#60	95.81							
	#200	64.51	#100	74.81							
			#200	44.96							
Remarks	Coefficients										
● 5-6.5 ft											
✘ 6 in-1 ft											

Laboratory tests are not valid if separated from original report.

Supporting Information

Contents:






General Notes

CPT General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

Sampling	Water Level	Field Tests
 <p>GeoProbe Macro Core or Large Bore</p>	<p> Water Initially Encountered</p> <p> Water Level After a Specified Period of Time</p> <p> Water Level After a Specified Period of Time</p> <p> Cave In Encountered</p> <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	<p>N Standard Penetration Test Resistance (Blows/Ft.)</p> <p>(HP) Hand Penetrometer</p> <p>(T) Torvane</p> <p>(DCP) Dynamic Cone Penetrometer</p> <p>UC Unconfined Compressive Strength</p> <p>(PID) Photo-Ionization Detector</p> <p>(OVA) Organic Vapor Analyzer</p>

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

CPT GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

DESCRIPTION OF GEOTECHNICAL CORRELATION

DESCRIPTION OF MEASUREMENTS AND CALIBRATIONS

To be reported per ASTM D5778:

Uncorrected Tip Resistance, q_c
Measured force acting on the cone divided by the cone's projected area

Corrected Tip Resistance, q_t
Cone resistance corrected for porewater and net area ratio effects
 $q_t = q_c + u_2(1 - a)$

Where a is the net area ratio, a lab calibration of the cone typically between 0.70 and 0.85

Pore Pressure, u
Pore pressure measured during penetration
 u_1 - sensor on the face of the cone
 u_2 - sensor on the shoulder (more common)

Sleeve Friction, f_s
Frictional force acting on the sleeve divided by its surface area

Normalized Friction Ratio, F_r
The ratio as a percentage of f_s to q_t , accounting for overburden pressure

To be reported per ASTM D7400, if collected:

Shear Wave Velocity, V_s
Measured in a Seismic CPT and provides direct measure of soil stiffness

Normalized Tip Resistance, Q_{tn}
 $Q_{tn} = ((q_t - \sigma_{v0})/P_a)(P_a/\sigma'_{v0})^n$
 $n = 0.381(I_c) + 0.05(\sigma'_{v0}/P_a) - 0.15$

Over Consolidation Ratio, OCR
OCR (1) = $0.25(Q_{tn})^{0.25}$
OCR (2) = $0.33(Q_{tn})$

Undrained Shear Strength, S_u
 $S_u = Q_{tn} \times \sigma'_{v0}/N_{kt}$
 N_{kt} is a soil-specific factor (shown on S_u plot)

Sensitivity, S_t
 $S_t = (q_t - \sigma_{v0}/N_{kt}) \times (1/f_s)$

Effective Friction Angle, ϕ'
 $\phi' (1) = \tan^{-1}(0.373[\log(q_t/\sigma'_{v0}) + 0.29])$
 $\phi' (2) = 17.6 + 11[\log(Q_{tn})]$

Unit Weight, γ
 $\gamma = (0.27[\log(F_r)] + 0.36[\log(q_t/\text{atm})] + 1.236) \times \gamma_{water}$
 σ_{v0} is taken as the incremental sum of the unit weights

Small Strain Shear Modulus, G_0
 $G_0 (1) = \rho V_s^2$
 $G_0 (2) = 0.015 \times 10^{(0.55I_c + 1.68)}(q_t - \sigma_{v0})$

Soil Behavior Type Index, I_c
 $I_c = [(3.47 - \log(Q_{tn}))^2 + (\log(F_r) + 1.22)^2]^{0.5}$

SPT N_{60}
 $N_{60} = (q_t/\text{atm}) / 10^{(1.1268 - 0.2817I_c)}$

Elastic Modulus, E_s (assumes $q/q_{ultimate} \sim 0.3$, i.e. FS = 3)

$E_s (1) = 2.6\psi G_0$ where $\psi = 0.56 - 0.33\log Q_{tn, \text{clean sand}}$

$E_s (2) = G_0$

$E_s (3) = 0.015 \times 10^{(0.55I_c + 1.68)}(q_t - \sigma_{v0})$

$E_s (4) = 2.5q_t$

Constrained Modulus, M

$M = \alpha_M(q_t - \sigma_{v0})$

For $I_c > 2.2$ (fine-grained soils)

$\alpha_M = Q_{tn}$ with maximum of 14

For $I_c < 2.2$ (coarse-grained soils)

$\alpha_M = 0.0188 \times 10^{(0.55I_c + 1.68)}$

Hydraulic Conductivity, k

For $1.0 < I_c < 3.27$ $k = 10^{(0.952 - 3.04I_c)}$

For $3.27 < I_c < 4.0$ $k = 10^{(-4.52 - 1.37I_c)}$

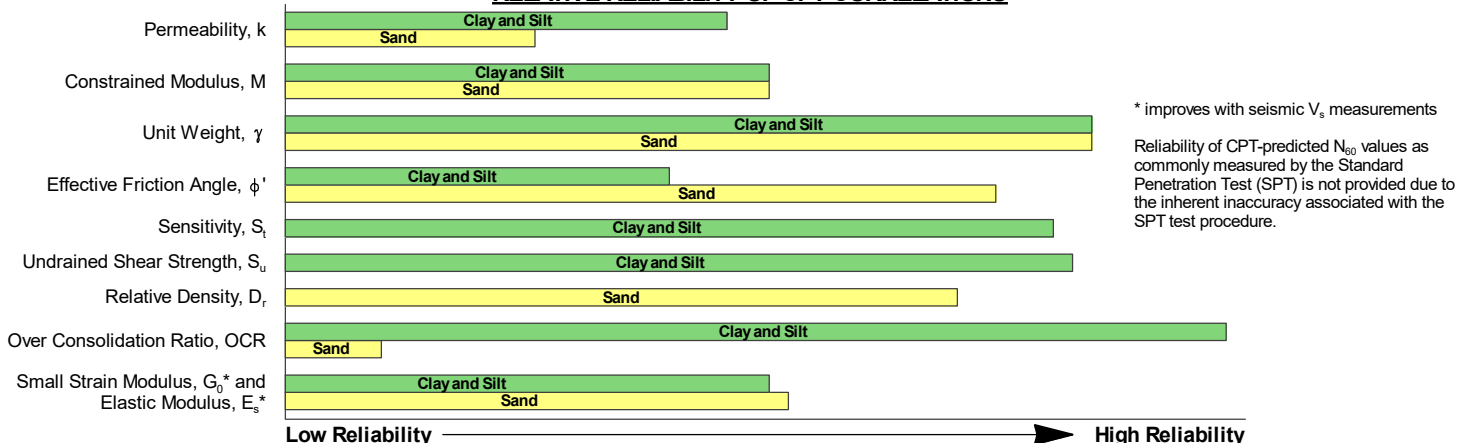
Relative Density, D_r

$D_r = (Q_{tn} / 350)^{0.5} \times 100$

REPORTED PARAMETERS

CPT logs as provided, at a minimum, report the data as required by ASTM D5778 and ASTM D7400 (if applicable). This minimum data include q_t , f_s , and u . Other correlated parameters may also be provided. These other correlated parameters are interpretations of the measured data based upon published and reliable references, but they do not necessarily represent the actual values that would be derived from direct testing to determine the various parameters. To this end, more than one correlation to a given parameter may be provided. The following chart illustrates estimates of reliability associated with correlated parameters based upon the literature referenced below.

RELATIVE RELIABILITY OF CPT CORRELATIONS



WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated":

Measured - Depth to water directly measured in the field

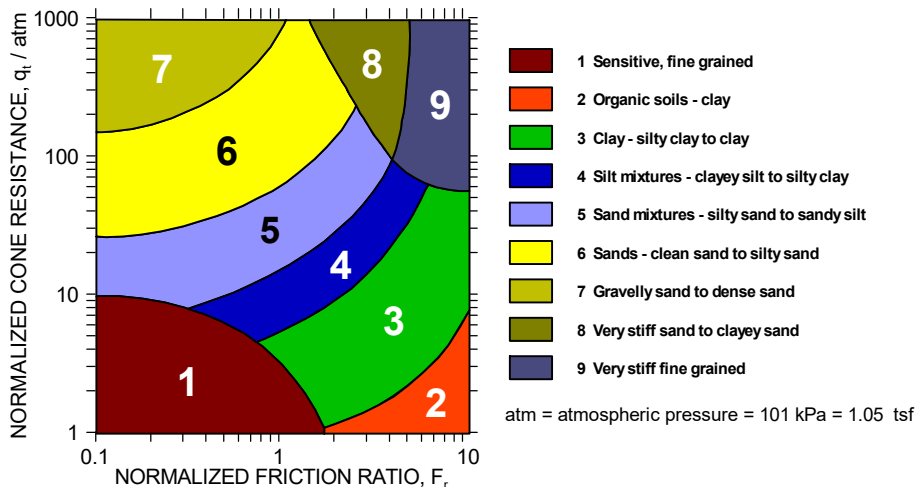
Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions

While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance (q_t), friction resistance (f_s), and porewater pressure (u_2). The normalized friction ratio (F_r) is used to classify the soil behavior type.

Typically, silts and clays have high F_r values and generate large excess penetration porewater pressures; sands have lower F_r 's and do not generate excess penetration porewater pressures. The adjacent graph (Robertson *et al.*) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



REFERENCES

Kulhavy, F.H., Mayne, P.W., (1997). "Manual on Estimating Soil Properties for Foundation Design," Electric Power Research Institute, Palo Alto, CA.
 Mayne, P.W., (2013). "Geotechnical Site Exploration in the Year 2013," Georgia Institute of Technology, Atlanta, GA.
 Robertson, P.K., Cabal, K.L., (2012). "Guide to Cone Penetration Testing for Geotechnical Engineering," Signal Hill, CA.
 Schmertmann, J.H., (1970). "Static Cone to Compute Static Settlement over Sand," *Journal of the Soil Mechanics and Foundations Division*, 96(SM3), 1011-1043.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F
		Gravels with Fines: More than 12% fines ^C	$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F
			Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	Fines classify as CL or CH	GC
	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E			SW	Well-graded sand ^I
	Sands with Fines: More than 12% fines ^D		$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I
			Fines classify as ML or MH	SM	Silty sand ^{G, H, I}
	Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line ^J	CL
PI < 4 or plots below "A" line ^J				ML	Silt ^{K, L, M}
Organic:			$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$	OL	Organic clay ^{K, L, M, N} Organic silt ^{K, L, M, O}
			Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line
PI plots below "A" line		MH			Elastic silt ^{K, L, M}
Organic:		$\frac{LL \text{ oven dried}}{LL \text{ not dried}} < 0.75$		OH	Organic clay ^{K, L, M, P} Organic silt ^{K, L, M, Q}
		Highly organic soils:		Primarily organic matter, dark in color, and organic odor	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

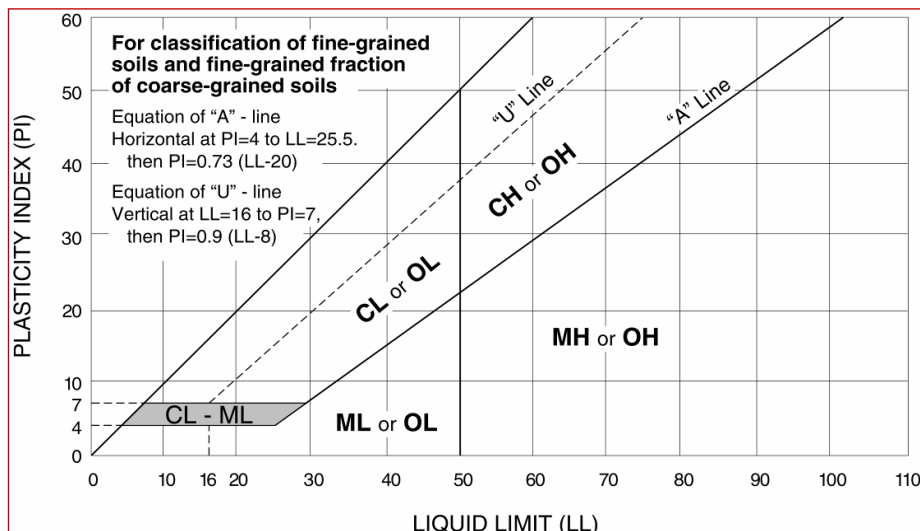
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 PROJECT INFORMATION

- A. Project Identification: Pitt Community College New welding Building.
 - 1. Project Location: Pitt Community College, Winterville, NC.
- B. Owner: Pitt Community College.
 - 1. Owner's Representative: Ricky Brown, Vice President of Administrative Services.
- C. Architect: JKF ARCHITECTURE PC, Greenville, NC.
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. PME Engineering: Atlantec Engineering, Raleigh, NC.
 - 2. Civil Engineering: Rivers & Associates, Greenville, NC
 - 3. Structural Engineering: Nesar & Roomsburg, Virginia Beach, VA

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. Construction of a new 29,879 GSF, 1-story Welding Building, that includes, but not limited to:

- a. Site work and development, concrete footings, foundations, and slab on grade, steel building frames, metal deck, bar joists, CMU/brick veneer, cold-formed metal framing, sheathing, insulation, aluminum windows/curtainwall/storefront/doors, FRP doors, Standing seam metal roof, composite and corrugated wall panels, and translucent wall panels.
- b. Interior construction of walls, new doors, new metal stud wall systems, new flooring, painting, ceilings, all glass walls/doors, aluminum interior frames, wood doors, hollow metal frames, hardware, laminate casework, painting, welding booth, signage;
- c. New Fire Protection System, Fire Pump, Plumbing, HVAC, and all new electrical New Fire Protection, and new Fire Alarm;

B. Type of Contract:

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

1.5 PHASED CONSTRUCTION

- A. The Work shall be conducted in a single phase.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

- B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

- C. Owner-Furnished/Contractor-Installed (OFCI) Products:

1. Security System and Card Readers.

1.7 ACCESS TO SITE

- A. General: Contractor shall have full use within the Project Limits for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Nonsmoking Building: Smoking is not permitted within the building or on-site.
- C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
- C. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices.

1.3 ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. **Allowance No. 1: Remove Unsuitable Soils:**
 - 1. Description: Remove and disposal off-site and replace of unsuitable soils in building pad or parking areas, excluding that required for footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes compacted sand fill as specified in Section 312000 "Earth Moving." Material, labor to remove, dispose, and install, fill materials, supervision, overhead and profit, delivery charges, etc., are to be included in the Base Bid. Final quantities

necessary for the project will be based on actual quantities determined by the Owner's testing agency and confirm by Designers. Adjustments made based on the final quantities shall be per Unit Price #1.

2. Base Bid Quantity to be included in Base Bid: 1,500 CY.
3. On Bid Form indicated Lump Sum dollar amount for Base Bid Quantity.
4. No changes in the Contract duration for the first 1,500 CY that require removal and replacement. If quantities exceed 1,500 CY, adjustments to duration will be made by Unit Price #1.

B. Allowance No. 2: Remove Unsuitable Soils (#57 Stone):

1. Description: Remove and dispose off-site and replace unsuitable soils in footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes #57. Labor to remove, dispose, and install, fill materials, supervision, overhead and profit, delivery charges, etc., are to be included in the Base Bid. Final quantities necessary for the project will be based on actual quantities determined by the Owner's testing agency and confirm by Designers. Adjustments made based on the final quantities shall be per Unit Price #2.
2. Base Bid Quantity to be included in Base Bid: 1,000 CY.
3. On Bid Form indicated Lump Sum amount for Base Bid Quantity.
4. No changes in the Contract duration for the first 1,000 CY that require removal and replacement. If quantities exceed 1,000 CY, adjustments to duration will be made by Unit Price #2.

END OF SECTION 012100

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

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

1.4 PROCEDURES

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

- A. **Unit Price No. 1** - Remove and replace unsuitable soils in building pad or parking areas.

1. Description: Remove and replace unsuitable soils in building pad or parking areas, excluding that required for footings, foundations, and utility trenches, as directed by the architect. Suitable fill material includes compacted sand fill above that required by the Contract Documents including Allowances, as directed by the Architect.
 2. Unit of Measurement: Per cubic yard in place.
 3. Add 1 calendar day to the Contract duration for every part of 200 CY of unsuitable soils removed. No extended overhead recovery will be permitted as part of this Unit Price.
- B. Unit Price No. 2 - Remove and replacement unsuitable soils in footings, foundations, and utility trenches.**
1. Description: Remove and replacement unsuitable soils in footings, foundations, and utility trenches, as directed by the architect. Suitable fill material may include compacted sand fill or #57 stone directed by the Architect, but use of either shall not alter the unit price.
 2. Unit of Measurement: Per cubic yard in place.
 3. Add 1 calendar day to the Contract duration for every part of 200 CY of unsuitable soils removed. No extended overhead recovery will be permitted as part of this Unit Price.
- C. Unit Price No. 3 - Provide geotechnical fabric, geogrid, or other suitable stabilization material.**
1. Description: Upon approval of the Architect, utilized geotechnical fabric to stabilized areas of unsuitable soils including building pad and parking area preparation. Building pad includes entire building area including excavations for footings, foundations, and utility trenches.
 2. Unit of Measurement: Per square yard in place.
 3. Add 1 calendar day to the Contract duration for every part of 500 SY of fabric installed. No extended overhead recovery will be permitted as part of this Unit Price.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 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 or deducted from the base bid amount if 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 or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 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. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. 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 Bid No. 1**– Add Two Additional Classrooms.
 - 1. Description: Add to Base Bid the cost for adding two additional Classrooms 119 and 120 as indicated on the Contract Documents. Alternate includes all sitework, architectural, structural, fire protection, plumbing , HVCA, and electrical systems.
 - 2. Time Impact: If accepted, 21 days added to Base Bid.
- B. **Alternate Bid No. 2**– Add Exterior Canopies.
 - 1. Description: Add to Base Bid the cost for adding three exterior metal canopy sections indicated as Alternate Bid #2 on the Contract Document. Canopy lengths are 46'-4", 47'-0", and 48'-8", respectively in length by 20'-0". Includes footings and foundations, exterior lighting, and fire protection systems as noted.
 - 2. Time Impact: If accepted, 7 days added to Base Bid.
- C. **Alternate Bid No. 3**– Preferred Alternate; Fire Alarm- JCI/Simplex.
 - 1. Description: Add to Base Bid the cost for providing JCI/Simplex Fire Alarm System where indicated as Basis of Design.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- D. **Alternate Bid No. 4**– Preferred Alternate; Building Controls- Schneider Electric.
 - 1. Description: Add to Base Bid the cost for providing Schneider Electric for Building Controls System where indicated as Basis of Design.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- E. **Alternate Bid No. 5**– Preferred Alternate; Boilers- Lochinvar.
 - 1. Description: Add to Base Bid the cost for providing Lochinvar Boilers where indicated as Basis of Design.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- F. **Alternate Bid No. 6**– Preferred Alternate; Chillers- Trane.
 - 1. Description: Add to Base Bid the cost for providing Trane Chillers where indicated as Basis of Design.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- G. **Alternate Bid No. 7**– Preferred Alternate; Corbin-Russwin.
 - 1. Description: Add to Base Bid the cost for providing Corbin-Russwin Door Hardware where indicated as Basis of Design.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- H. **Alternate Bid No. 8**– Add Front Entrance Steel Canopy.
 - 1. Description: Add to Base Bid the cost for adding the painted steel entrance canopy as indicated on the Contract Documents. Alternate includes all associated footings, steel, plate roofing, and electrical work.
 - 2. Time Impact: If accepted, 0 days added to Base Bid.
- I. **Alternate Bid No. 9A**– Add Welding Stations with Filtration Units.

1. Description: Add to Base Bid the cost for adding specified Welding Stations in Beginners Welders Lab (72 total with 36 paired Filtration Units) as indicated on the Contract Documents. Alternate includes installation of units, final electrical and all final utility connections.
 2. Time Impact: If accepted, 0 days added to Base Bid.
- J. **Alternate Bid No. 9B**– Add Welding Stations with Filtration Units.
1. Description: Add to Base Bid the cost for adding specified Welding Stations in two Advanced Welding Lab (24 total with 12 paired Filtration Units) as indicated on the Contract Documents. Alternate includes installation of units, final electrical and all final utility connections.
 2. Time Impact: If accepted, 0 days added to Base Bid.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 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.

1.4 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. Substitution Request Form: Use Contractor's Standard Form.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination 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 substitution 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.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and 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 substitution 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.
3. 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.

1.5 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.

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 30 days after Notice to Proceed.
 - 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. Requested substitution provides sustainable design characteristics that specified product provided.

- c. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. 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 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on "Architect's Supplemental Instructions."

1.4 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 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.
- e. Quotation Form: Use forms acceptable to Architect.

- 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.

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 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

1.7 CONSTRUCTION CHANGE DIRECTIVE OR FIELD ORDER

- A. Construction Change Directive: Architect may issue a Construction Change Directive on Field Order Form. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains 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.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 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 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than 21 days after notice to proceed. Provide separate schedule for each Armory.
- B. Format and Content: Use the 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. Submit draft of AIA Document G703 Continuation Sheets.
 - 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
 - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 5. 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.

1.5 APPLICATIONS FOR PAYMENT

- A. Each 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 Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. 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 of Approved Change Orders issued before last day of construction period covered by application.
- E. Transmittal: Submit 4 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.
- F. Initial Payment: Initial Application for Payment will not be reviewed or executed until the following administrative submittals are submitted and approved by the Architect:
 - 1. Project Schedule.
 - 2. List of Subcontractors, materials, products.
 - 3. Schedule of Values.
 - 4. Submittal Schedule.
- G. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. NC State Construction Forms "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. NC State Construction Forms "Contractor's Affidavit of Release of Liens."
 - 6. NC State Construction Forms "Consent of Surety to Final Payment."
 - 7. Summary of all MBE's paid for project. Use Appendix E to Summarize.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.3 DEFINITIONS

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

1.4 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, and telephone number 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.
 - 4. Name of Product and Manufacturer to be provided by the Subcontractor.
 - 5. Submit Subcontract List within 30 days of Notice to Proceed.
- B. Key Personnel Names: Within 30 days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 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.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:

- a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
- a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
- 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 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.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- 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 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.
 - 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 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 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect 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 monthly. Contractor's standard form acceptable to the Architect
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS

- A. Preconstruction Conference: Architect 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. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner Architect, 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.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.

- e. Lines of communications.
- f. Procedures for processing field decisions and Change Orders.
- g. Procedures for RFIs.
- h. Procedures for testing and inspecting.
- i. Procedures for processing Applications for Payment.
- j. Distribution of the Contract Documents.
- k. Submittal procedures.
- l. Preparation of record documents.
- m. Use of the premises.
- n. Work restrictions.
- o. Working hours.
- p. Owner's occupancy requirements.
- q. Responsibility for temporary facilities and controls.
- r. Procedures for moisture and mold control.
- s. Procedures for disruptions and shutdowns.
- t. Construction waste management and recycling.
- u. Parking availability.
- v. Office, work, and storage areas.
- w. Equipment deliveries and priorities.
- x. First aid.
- y. Security.
- z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires 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 of scheduled meeting dates.
- 2. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 3. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 4. 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.

C. Progress Meetings: Architect will conduct progress meetings at monthly intervals.

- 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. Contractor shall provide a written summary of the project status in the following format at each meeting:
 - a. Review outstanding items from previous minutes.
 - b. Contractors current status complete with written summary.
 - c. Contractors work to be performed next period, written summary.
 - d. Change Order status

- e. Shop Drawing status.
- f. Project Schedule.
- g. Other.
- h. 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.

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.

D. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

- 1. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
 - 3. Two paper copies.

- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- C. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, 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 all activities sorted by activity number and then early start date, or actual start date if known.
- D. Daily Construction Reports: Submit at monthly intervals.

1.5 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, 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.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Project 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.
- B. Activities: Treat each story 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 013300 "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. Pre-Final: Indicate completion in advance of date established for Project Acceptance and allow time for Architect's administrative procedures necessary to schedule Final Inspections.
 - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

- C. 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. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Uninterruptible services.
 - b. Use of premises restrictions.
 - c. Environmental control.
 2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 3. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Pre-final inspections, and final completion, and the following interim milestones:
1. Temporary enclosure and space conditioning.
 2. Power on Building.
 3. Critical inspections such as under slab rough-in, above ceiling inspections, wall rough-ins, etc.
- E. 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 Contract Time.
- F. 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, and equipment required to achieve compliance, and date by which recovery will be accomplished.

- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 REPORTS

- A. 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. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (see special reports).
 - 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 Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Architect within seven day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

- C. Submit 5-year weather data for the previous 5-years at the beginning of the Project within 30 days of Notice to Proceed. Data shall indicate the average number of days per month with precipitation that will serve as baseline for any weather days to be claimed in excess of the 5-year averages.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule 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.
- B. Distribution: Distribute copies of approved schedule to Architect 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.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 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."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule 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. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

- b. Finalize the schedule such that all shop drawings required for the project are submitted within 90 days of Notice to Proceed.
4. Format: Arrange the following information in a tabular format:
- a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
- 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Architects current AutoCAD version.
 - c. Contractor shall sign Architect's standard release form
 - d. The following digital data files will be furnished for each appropriate discipline:
 - 1) Basic Floor plans.
 - 2) Basic Reflected ceiling plans.
- 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. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- 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 20 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. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 20 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 20 days for initial review of each submittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number or other unique identifier, including revision identifier.
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 - a. Transmittal Form for Paper Submittals: Use Contractors Standard Transmittal.
 - b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Construction Manager.
 - 7) Name of Contractor.
 - 8) Name of firm or entity that prepared submittal.
 - 9) Names of subcontractor, manufacturer, and supplier.
 - 10) Category and type of submittal.
 - 11) Submittal purpose and description.
 - 12) Specification Section number and title.
 - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 14) Drawing number and detail references, as appropriate.

- 15) Indication of full or partial submittal.
- 16) Transmittal number, numbered consecutively.
- 17) Submittal and transmittal distribution record.
- 18) Remarks.
- 19) Signature of transmitter.

- E. Electronic Submittals:(Limit to those submittals pre-approved for electronic submission by the Architect): Identify and incorporate information in each electronic submittal file as follows:
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. FOLLOW ARCHITECT'S "ELECTRONIC SHOP DRAWING PROTOCOL" FORMAT NOTED IN PARAGRAPH 3.3 AT THE END OF THIS SECTION.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Transmittal Form for Electronic Submittals: Use Outlook Formatted e-mail as transmittal to Architect, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Indication of full or partial submittal.
 - n. Transmittal number, numbered consecutively.
 - o. Submittal and transmittal distribution record.
 - p. Other necessary identification.
 - q. Remarks.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. 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.

- J. 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.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit up to 5 paper copies of each submittal unless otherwise indicated. Architect will return two copies.
 - 3. Informational Submittals: Submit up to 5 paper copies of each submittal unless otherwise indicated. Architect will not return copies.
 - 4. Certificates and Certifications Submittals: Provide 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.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. 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 not suitable 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.
 - 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 showing 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 or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
 - b. Up to 5 paper copies of Product Data unless otherwise indicated. Architect will return two copies.
- C. 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.
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.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
 - b. Up to 5 opaque copies of each submittal. Architect will retain two copies; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. 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.
 - 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.
 4. 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 2 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.

- 5. 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 1 Sample sets; remainder will be returned.
 - 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.

- E. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

- F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

- J. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

- K. 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.

- L. 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.

- M. 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.

- N. 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.

- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. 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.
- R. 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.
- S. 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- T. 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.
- U. 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.
- V. 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.
- W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 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 not sufficient 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 up to 5 paper copies 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action 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. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, 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.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Reviewed: Information submitted is in compliance with Contract Documents.
 - 2. Reviewed as Noted: Information submitted is in compliance with Contract Documents except as noted.
 - 3. Revise and Resubmit: Submittal does not meet Contract Documents or is incomplete, and must be resubmitted.
 - 4. Not Reviewed: Incomplete submittal, was not required or does not require review.
- 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. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

3.3 ELECTRONIC SHOP DRAWING PROTOCOL

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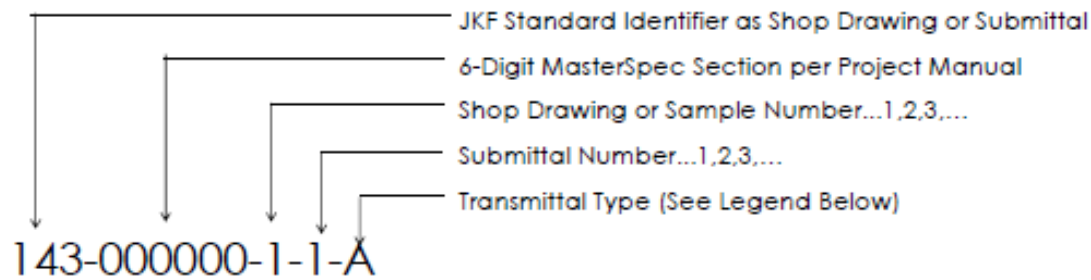
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If a Contractor shall wish to submit shop drawings, project data, etc. electronically, than the JKF naming protocol shall be used as indicated below. Shop Drawings and Product Data shall be individually classified by Specification Section. Do not combine specifications within a Division. For instance, do not combine hollow metal frames, wood doors and hardware all as one PDF submittal. Breakdown all PME items into their specification components. Failure to do so will cause the submittal to be rejected.

STEP 1: Prepare your PDF submittal using the format below. For instance, a submittal of the Hardware Schedule would be named 143-087100-1-1-SD. This means it is the first submittal item for this section and the 1st submittal of this item (...1-1-...). A resubmittal of the same item if rejected the first time would be 143-087100-1-2-SD, where the 2 indicates 2nd submittal. If hardware product data was submitted, it would be named 143-087100-2-1-PD, indicating the 2nd submittal for this section, and the 1st submittal. All items must include the Contractors approval.

STEP 2: Transmit to JKF via email and use the email as your transmittal. We will not keep extraneous transmittals. JKF can provide you a transmittal template that can be saved in Outlook. All e-mails for submittals shall be sent to:

submittal@jkg-arch.com



Transmittal Type

- A** Transmittal from GC
- B** Transmittal from Architect to Consultant
- C** Transmittal from Consultant to Architect
- D** Transmittal Architect to GC
- E** Transmittal Architect to Owner
- SD** Shop Drawing (Actual Documents to be Reviewed)
- PD** Product Data (Actual Documents to be Reviewed)
- SM** Sample



STEP 3: JKF ARCHITECTURE will initially review the submittal for formatting and content compliance. If required, we will forward the PDF to the required consultants for review and approval.

STEP 4: Consultants shall review the submittal and return using the same exact file name as was sent from JKF ARCHITECTURE.

STEP 5: JKF ARCHITECTURE will conduct final review for coordination and e-mail back to Contractor with final action.

STEP 6: Any further resubmittals shall follow the naming protocol that includes numbering for subsequent resubmittals for the same item.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. 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.
- B. 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. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, 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 Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
 - 2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, 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.

- D. 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.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. 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, 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).
- J. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards 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 a decision 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.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data : For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. 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.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- C. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- D. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified.

Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

- E. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 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, and telephone number 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 inspecting.
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 reinspecting.

- 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. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. 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. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 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.
- 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, 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 inspecting indicated, as documented according to ASTM E 329; 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 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. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, 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, 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 in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed unless otherwise indicated.

1.10 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 inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting 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 Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
- 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **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 013300 "Submittal Procedures."
- D. **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 preinstallation 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.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Testing Agency Responsibilities:** Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location 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.
 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 any duties of Contractor.
- G. **Associated Services:** Cooperate with agencies 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 inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency and special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect 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 with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial 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 reinspecting 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 reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, 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 017300 "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 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Contractor Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Contractor Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Contractor will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Contractor shall pay for all temporary electrical, water, and sewer services required for the project. Coordinate any tap fees, electrical service fees, and/or impact fees with local utility companies and local jurisdiction.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. HVAC system isolation schematic drawing.
 2. Location of proposed air-filtration system discharge.
 3. Waste handling procedures.
 4. Other dust-control measures.

1.5 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.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in 2012 NC Building Code, the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 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 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: 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 12 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.
 - 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.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 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.
 - 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.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 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.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

- 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.

3.2 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 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. 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. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- 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.
 - 2. Install lighting for Project identification sign.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
 - 1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine in each field office.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- J. Electronic Communication Service: Project electronic documents and maintain electronic communications and the following:
1. Provide wireless in Construction trailer.

3.3 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 E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Project Acceptance. Personnel remaining after Project Acceptance 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 within construction limits indicated on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas.
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- D. 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.
- E. Parking: Provide temporary parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
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.
- G. Project Signs: Provide Project signs as indicated on Drawing A8.1. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.

2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- I. 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.
- J. Temporary Elevator Use: See Section 142400 "Hydraulic Elevators" for temporary use of new elevators.
- K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Project Acceptance.

3.4 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.
- 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. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys each to Owner and Architect.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. 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.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- K. 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.
 - 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 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.
- L. Temporary Sign; Fire arms prohibited from construction site.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.

5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

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. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. 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 Project Acceptance. 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. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
 - 1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 3. Products:

- a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

- 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

- 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "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.

- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
 - 1. Select products for which sustainable design documentation submittals are available from manufacturer.

- 2.2 COMPARABLE PRODUCTS
 - A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.

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. Use materials that are not considered hazardous.
- C. 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.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility 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.
 1. Contractor shall engage a Professional Locating Company to locate all private utilities within the construction area and also engage 811 for all public utilities.
- 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 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 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.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- 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 Substantial 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: Do not use tools or equipment that produce harmful noise levels.
- 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 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. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 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. 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.
- C. 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 minimize interruption to occupied areas.
- D. 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.
- E. 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.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.

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.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 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 Substantial 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 017419 "Construction Waste Management and Disposal."

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

3.8 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.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Project Acceptance.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Project Acceptance procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Pre-Final.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Per State Construction Close-out List.
- C. Certificate of Insurance: For continuing coverage.
- D. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 PRE-FINAL 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 Pre-Final Inspection by Architect: Complete the following a minimum of 7 days prior to requesting Architect's Pre-Final 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, final completion construction photographic documentation, 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 where applicable.
 4. Contractor's statement of completion with request for designer's Pre-Final inspection
 5. Certificate of Occupancy by Local Authority Having Jurisdiction:
 6. Installer's Fire Alarm System Record of Completion (Certification) as required by NFPA 72:
 7. Installer's Sprinkler System Record of Material and Test Reports as required by:
 - a. NFPA 13-(Sprinkler Systems)
 - b. NFPA 14-(Standpipe and Hose Systems)
 - c. NFPA 20-(Centrifugal Fire Pumps)
 - d. Local Approval Letter of Sprinkler System Design
 8. Dept. of Labor Approval for Elevator.
 9. Dept. of Labor Approval for Boiler & Pressure Vessels
 10. Domestic Water Test Report and Acceptance for Use:
 11. Laboratory Hood Certification
 12. Engineer's Approval of Test and Balance Report(TAB)
 13. NEC Load Tests: Battery Powered Emergency Devices
 14. Emergency Generator Load Test
 15. Installer's Electrical Service Ground Test Report
- C. Inspection: Submit a written request for Pre-Final inspection a minimum of 7 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.
 3. A Final Inspection with State Construction will not be scheduled until the Contractor completes the punchlist items in particular all life-safety related items.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Complete all punchlist items from Pre-Final inspection.
 2. Advise Owner of pending insurance changeover requirements.
 3. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 5. Advise Owner of changeover in heat and other utilities.
 6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 7. Complete final cleaning requirements, including touchup painting.

8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Procedures Prior to Final Acceptance: Complete the following a minimum of 7 days prior to requesting State Construction inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.
 - C. 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. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.
 1. State Construction, the Architect, and the Owner may accept the Project and issue a Project Acceptance Form for minor items. These items are to be completed within 30 days after acceptance. Failure to complete the outstanding items will necessitate issuance of a 15 notice by the Architect, after which the Owner may initiate completion of the outstanding items and withhold any costs incurred from the Contractor's final payment request.
 2. Reinspection: If the Project is not accepted, request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- 1.8 SUBMITTAL OF PROJECT WARRANTIES
- A. Time of Submittal: Submit written warranties effective the day after Project Acceptance.
 - B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 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.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - C. 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.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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 Substantial Completion for entire Project or for a designated portion of 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. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

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

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

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

- C. Initial Manual Submittal: Submit draft copy of each manual at Pre-Final Inspection. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 7 days before commencing demonstration and training. Architect will return copy with comments.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

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

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for 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.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive 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 below first floor.
 - 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 Construction Change Directive.
 - 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 Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Specifications as paper copy.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

END OF SECTION 017839

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 1. Footings.
 2. Slabs-on-grade.
 3. Suspended Slab

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Steel reinforcement and accessories.
 4. Curing compounds.
 5. Floor and slab treatments.
 6. Bonding agents.
 7. Adhesives.

8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

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. 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.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Preinstallation Conference: Conduct conference at Project site.
 1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. 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:

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
- C. Water: ASTM C 94/C 94M and potable.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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.

2.5 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.6 CURING MATERIALS

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

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 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 Percentages in subparagraphs below repeat ACI 301 limits for concrete exposed to deicing chemicals.
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 5 inches, plus or minus 1 inch.
- B. Normal-weight concrete used for Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45
 - 3. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
 - 4. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches (200 mm), plus or minus 1 inch (25 mm) for concrete with verified slump of 3 inches (75 mm), plus or minus 1 inch (25 mm), before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Air Content for exterior concrete: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
 - 6. Air Content for interior slabs: Do not allow air content of trowel-finished floors to exceed 3 percent.
- C. Normal-weight concrete used for interior suspended slabs.

1. Minimum Compressive Strength: 3000 psi (27.6 MPa) at 28 days.
2. Maximum w/cm: 0.45.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm); or 8 inches (200 mm), plus or minus 1 inch (25 mm) for concrete with verified slump of 3 inches (75 mm), plus or minus 1 inch (25 mm), before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.10 FABRICATING REINFORCEMENT

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

2.11 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.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

- 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's "Code of Standard Practice for Steel Buildings and Bridges." "Wet Setting" anchor rods is not permitted.

3.2 VAPOR RETARDERS

- 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.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing 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 would 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.
- D. 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.

3.4 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 as indicated into concrete.
- 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. 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 will 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. 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.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be 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 to not 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.
- D. 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.
- E. 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.
- F. 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.

3.6 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. 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.

3.7 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. 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 restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish .
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
- E. 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 thin-set 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.
- F. 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.

3.8 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 the remainder of the 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:
 - 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 will not interfere with bonding of floor covering used on Project.
- 3. Curing Compound: Apply uniformly in 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. Maintain continuity of coating and repair damage during curing period.

3.9 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 six 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 joint 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.

3.10 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 one part portland cement to two and one-half 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 will match 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. 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.
 6. 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.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: 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. Headed bolts and studs.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 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.
 - a. When frequency of testing will provide 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.

2. 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.
3. Air Content: ASTM C 231, 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.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
6. 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 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.
7. 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.
8. 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.
9. 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.
10. 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.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 033000

SECTION 042000 - 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. Clay face brick.
 - 3. Mortar and grout.
 - 4. Steel reinforcing bars.
 - 5. Masonry-joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Steel lintels in unit masonry.

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 Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Clay face brick, in the form of straps of five or more bricks.
3. Weep holes/cavity vents.

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

1. Exposed CMUs.
2. Clay face brick, in the form of straps of five or more bricks.
3. Special brick shapes.
4. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
5. Cavity vents.
6. Accessories embedded in masonry.

E. Sustainable Design Submittals: For items noted in body of specification.

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 masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. 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 SPECIAL REQUIREMENTS

- A. The Work of this Section shall be bid and provided as a single lump sum subcontract to the General Contractor (Square foot/ unit pricing of masonry labor and General Contractor furnished materials is not permitted). The Masonry Subcontractor shall be a firm, who specializes in masonry construction and shall furnish all materials, equipment, and labor required to complete the required masonry construction for this project.
- B. Lump Sum Masonry Contractors through the General Contractor, shall upon request of the Architect/ Owner provide evidence of at least 5 years experience with 5 projects of equivalent size and scope of experience performing work as a Lump Sum Masonry Contracting Firm.
- C. Masonry subcontractor shall not act as a broker, but shall perform the Work of this section with its own forces. Upon request of the Architect, General Contractor shall provide a copy of the Contract between General Contractor and Masonry Subcontractor (contract amounts may be omitted) indicating their contract is a lump sum contract.
- D. Additionally, the work of this section shall be bid and performed by a firm certified as a “North Carolina Masonry Contractors Association Certified Masonry Contractor” as described in the most current version of the NCMCA’s “Guide to Masonry Contractor Certification.” (North Carolina Masonry Contractors Association, PO Box 3463, Hickory, NC 28603-3463, (828) 324-1564, information@ncmca.com) . The masonry subcontractor shall at all times when work is in progress, provide an individual from its own staff designated by the North Carolina Masonry Contractors Association Masonry Contractor Certification Program as a “CMP-Certified Masonry Professional” or “CME-Certified Masonry Executive” (as described in the most current version of the NCMCA’s “Guide to Masonry Contractor Certification”) on-site to supervise work in progress.
- E. Definition: Lump Sum Masonry Subcontractor shall be a firm specializing in lump sum masonry contracting work and shall have been in masonry construction business for at least 5 years. Subcontracting of masonry work is discouraged and if allowed the masonry subcontractor shall be responsible for the performance of its subs and shall continually supervise and inspect their work. The masonry subcontractor shall have a superintendent and crew chiefs (from its own staff) on site supervising all the masonry work.
 - 1. A listing of masonry contractors capable of providing a lump sum bid is available from the North Carolina Masonry Contractor’s Association at 828-324-1564 (828-324-2179, fax) or on the Internet at www.ncmca.com.
- F. Daily preliminary cleaning of masonry is required for this project. The masonry subcontractor shall provide a person(s) to perform this task daily.
- G. If final cleaning of the masonry is to be subcontracted, the masonry subcontractor shall be responsible to supervise the cleaning operations, coordinate the type and application of cleaning materials in accordance with specific manufacturer’s written recommendations. Masonry subcontractor shall certify to the Owner through the Architect that the proper cleaners were used, at the proper application rates, and complied with manufacturer’s recommendations.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 60 inches high by full thickness, including face and backup wythes and accessories.
 - a. Include a sealant-filled joint at least 16 inches long in each mockup.
 - b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
 - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
 - d. Include metal studs, sheathing, water-resistive barrier sheathing joint-and-penetration treatment, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
 - e. Include clay face brick on one face of interior unit masonry wall mockup.
 - 2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 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. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. 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.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 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 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. 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.
- B. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 - 2. Density Classification: Lightweight unless otherwise indicated.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 MASONRY LINTELS

- A. General: Provide one of the following:
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C 216.

1. Grade: MW or SW.
2. Type: FBX.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4150 psi.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Size (Actual Dimensions): 3-5/8 inches wide by 2-2/3" inches high by 7-5/8 inches long.
7. Application: Use where brick is exposed unless otherwise indicated.
8. Color and Texture:
 - a. Taylor Clay Products Inc.; Match Existing Campus Brick
 - b. Equivalents from Belden, Boral.

2.7 MORTAR AND GROUT MATERIALS

A. 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.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

G. 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.

H. Aggregate for Grout: ASTM C 404.

I. 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.

- J. Water: Potable.

2.8 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M, 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.
- 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.

2.9 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. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 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 heavy-duty flattened errated pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 - 3. Wire: Fabricate from 1/4-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 0.25-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. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated] [bent to configuration indicated].
 - 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M] [Epoxy coating 0.020 inch thick.

2.10 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 - 1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
 - 2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
 - 3. 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.
 - 4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 - 5. 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.
 - 6. Fabricate through-wall flashing with sealant stop unless otherwise 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.
 - 7. 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.
 - 8. 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.
 - 9. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
 - 10. Solder metal items at corners.
- A. Flexible Flashing: Use the following unless otherwise indicated:
 - 1. Laminated Stainless Steel Fabric Flashing. Non-Asphaltic: Use the following unless otherwise indicated:
 - 2. Stainless steel core with polymer fabric laminated to stainless steel face with non-asphaltic adhesive. Stainless steel type: 304, ATM A167. Fabric: polymer fabric; laminated back face of stainless steel core.
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) York Manufacturing, Inc.; Multi-Flash SS
 - 2) STS Coatings, Inc.; Gorilla Flash Stainless Fabric

- 3) Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing
 - 4) TK Products, Inc.; TK TWF
 - b. Accessories: Form the stainless steel flashing in the field or use 26 gauge stainless steel pre-manufactured corners
- B. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 3. Where flashing is fully concealed, use metal flashing and flexible flashing as detailed.
- C. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.
- D. 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.
- E. 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.

2.11 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 urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 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. Vinyl Weep Hole/Vent (For use in Brick Veneer): Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.
 - 2. Rectangular Plastic Weep/Vent Tubing (For use in Decorative CMU): Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches long.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Configuration: Provide one of 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.

2.12 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.

2.13 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. For exterior masonry, use portland cement-lime mortar.
 - 4. For reinforced masonry, use portland cement-lime mortar.
 - 5. 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 M.
 - 2. For reinforced masonry, use Type S.
 - 3. 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.
- D. Pigmented Mortar: Use colored cement product.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Mix to match Architect's sample.
 - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Cast-stone trim units.
- E. 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 2500 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. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. 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 078443 "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. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
 - 4. Rake out mortar joints for pointing with sealant.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- F. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, and air barriers unless otherwise indicated.

3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together as follows:

1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use tab-type reinforcement.
 2. 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. 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 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing and masonry backup with masonry-veneer anchors to comply with the following requirements:
1. Embed connector sections and continuous wire in masonry joints.
 2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 18" inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
- B. Provide not less than 2 ¼ inches of airspace between back of masonry veneer and face of insulation.
1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.8 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.

- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 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 2 inches 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.

3.10 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 as follows:
 - 1. 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.
- C. Form expansion joints in brick as follows:
 - 1. Build in compressible joint fillers where indicated.
 - 2. 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 079200 "Joint Sealants."

3.11 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 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 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of flashing embedded in inner wythe.
 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 079200 "Joint Sealants" for application indicated.
 6. 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.
 7. Install metal flashing termination 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 flashing termination.
 8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- E. Install cavity vents at 16 inches on center in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products 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.

3.13 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. 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.

3.14 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. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

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."

E. Alternative Allowable 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 using Pressurized Water Cleaning method described in BIA Technical Notes 20
 - a. Use a stainless steel 25 to 50 deg. fan tip, held a minimum of 12 in. (305 mm) from the brick surface
 - b. Do not use water pressures higher than 400 psi as measured at the nozzle tip unless
 - c. For pre-wetting, use very low pressure (less than 100 psi)
 - d. Saturate the area to be cleaned and brickwork below prior to applying cleaning solution, and keep wet until final rinse
 - e. Apply cleaning solution according to manufacturer's written directions instructions by brush or a chemical pump/tank sprayer with a wide-angle fan-shaped sprayer nozzle tip, maximum 30 to 50 psi.
 - f. For rinsing, use low pressure 400 psi maximum.
 - g. If contractor fails to comply with any of the above requirements, revert to Bucket and Brush Method only.
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. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 1. Crush masonry waste to less than 4 inches in each dimension.
 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. 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 042000

SECTION 051200 - STRUCTURAL STEEL 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. Structural steel.
2. Grout.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Show fabrication of AESS components.
 4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts.
- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Shop primers.
 - 3. Nonshrink grout.
- F. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using AISC 360.
 - 2. Use Allowable Stress Design.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Angles: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
- B. Headed Anchor Rods: ASTM F 1554, Grade 36, weldable, straight.
 - 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Plain.

2.4 PRIMER

- A. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.
- B. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
1. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 2. Mark and match-mark materials for field assembly.
 3. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.
1. Category AESS 3: Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
 3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
 4. Make intermittent welds appear continuous, using filler or additional welding.
 5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
 6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
 7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
 8. Remove weld spatter, slivers, and similar surface discontinuities.
 9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
- C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- D. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- F. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize all exterior steel, shelf angles and steel located in exterior walls.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Galvanized surfaces.
 4. Surfaces enclosed in interior construction.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M. Test groove welds using the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Erection of Category AESS 3:
 - 1. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
 - 2. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
 - 3. Remove weld spatter, slivers, and similar surface discontinuities.
 - 4. Grind off butt and plug weld projections larger than 1/16 inch.
 - 5. Continuous welds are to be of uniform size and profile.
 - 6. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
 - 7. Splice members only where indicated on Drawings.

8. No torch cutting or field fabrication is permitted.
 9. Weld profiles, quality, and finish are to be as approved by Architect.
 10. Make joint welds, including tack welds, appear continuous by filling intermittent welds.
- E. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- F. Splice members only where indicated.
- G. Do not use thermal cutting during erection.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
1. In addition to visual inspection, test and inspect field groove welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.

- b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
- c. Ultrasonic Inspection: ASTM E 164.
- d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- B. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST 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. K-series steel joists.
 - 2. Joist accessories.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of joist top chord extensions signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide joist top chord extensions capable of withstanding design loads indicated.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, parallel top chord, and special sloped seats.
 - 1. Joist Type: K-series steel joists.
- B. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- C. Do not camber joists.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- C. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- D. Welding Electrodes: Comply with AWS standards.
- E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications" and "joist manufacturer's written recommendations, and requirements in this Section."
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

- C. Field weld joists to supporting steel. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

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 deck.
 - 2. Composite floor deck.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for normal-weight structural concrete fill over steel deck.
 - 2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G90 zinc coating.
 - 2. Deck Profile: As indicated.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: As indicated.
 - 6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

- A. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
 - 2. Profile Depth: As indicated.
 - 3. Design Uncoated-Steel Thickness: As indicated.
 - 4. Span Condition: As indicated.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Galvanizing Repair Paint: ASTM A 780.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: As indicated.
 - 2. Weld Spacing: As indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops: Weld steel sheet pour stops to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Project Acceptance.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - PRODUCTS

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. Exterior non-load-bearing wall framing.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.

1.6 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST50H.
 - 2. Coating: G60.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1.
 - 2. Coating: G90.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.
 - 2. Flange Width: As indicated.
 - 3. Section Properties: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0538 inch.

2. Flange Width: 1-1/2 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 1. Minimum Base-Metal Thickness: As indicated.
 2. Flange Width: 1 inch plus the design gap for one-story structures.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 1. Supplementary framing.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- D. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.

2.7 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
 2. Connect vertical deflection clips to bypassing studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

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. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Shelf angles.
6. Alternating Tread Stairs.
7. Metal bollards.
8. Metal downspout boots.
9. Loose bearing and leveling plates for applications where they are not specified in other Sections.

- B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Metal nosings and treads.

3. Paint products.
4. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Shelf angles.
5. Metal bollards.
6. Metal downspout boots.
7. Loose bearing and leveling plates for applications where they are not specified in other Sections.

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 PERFORMANCE REQUIREMENTS ALTERNATING TREAD STAIRS

- A. Alternating Tread Stair Treads: shall be capable of withstanding a single concentrated 1000 pound load without permanent deformation; or 100 pounds per square foot or 300 pounds on an area of 4 square inches without exceeding the allowable working stress of the material.
- B. Alternating Tread Stair Guard/Handrail: shall be capable of withstanding a single concentrated load of 200 pounds or a uniform load of 50 pounds per linear foot applied in any direction at any point on the rail without exceeding the allowable working stress of the material.
- C. Alternating Tread Stair Stringers: shall be capable of withstanding a single concentrated load of 1000 pounds at any point on the stair without permanent deformation; or a uniform live loading of 100 pounds per square foot applied in a downward direction to all tread surfaces or a 300 pound load on an area of 4 square inches without exceeding the allowable working stress of the material

2.3 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- F. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- G. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Prime shelf angles located in exterior walls with zinc-rich primer.
- E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.9 ALTERNATING TREAD STAIRS

- A. Landings, Treads, and Mounting Base: shall be stamped and formed from single piece material. Stock shapes, hand forming, or welded remnants shall not be permitted. All stamped parts shall have integrally formed rigidizing bends and shall be spot welded to stringers of like material.
- B. Welds: shall be a minimum of 6 welds per tread, and 12 welds each on the landing and mounting base. Each weld shall be quality controlled and be capable of withstanding a minimum of 2800 lbs. in shear.
- C. Pedestrian Surfaces: shall be punched through with upset non-skid openings.
- D. Riser Spacing: shall be equally spaced to within 3/16" for adjacent risers and to within 3/8" for any two non-adjacent risers on a stair.
- E. Guards and Handrails: shall be contoured for body guidance and underarm support and shall be attached to the outside stringers and landings by bolting.
- F. Landing Reinforcement: shall be with 1/4" steel angle notched and punched and factory welded to the landing at the points of a guard or handrail attachment.

- G. Rubber Foot Divider: shall be affixed to the central portion of the landing. A rubber bumper strip shall be attached or will be provided for field attaching to the central stringer.
- H. Alternating Tread Stair Angle: 68 degrees from horizontal as specified in the drawings.
- I. Vertical Drop: the change in elevation, as shown in the drawings, between the upper finished floor surface where the top landing will be attached and the lower finished floor surface where the base of the alternating tread stair will be secured
- J. Materials:
 - 1. Carbon Steel:
 - 2. Treads: 13 Gauge AISI 1010/15 HRPO per ASTM A569 / A1011 grade 36 (or higher).
 - 3. Landing & Foot Stampings: 11 Gauge AISI 1010/15 per ASTM A569 / A1011 grade 36 (or higher). Top Landing Support Clips: L2 x 2 x 1/4" x 4" lg. with 5/8" Φ round holes and 5/8" x 1" slot holes, ASTM A569/A1011 grade 36 (or higher)
 - 4. Stringers: 3" x 1 3/4" x 11 Gauge U section; AISI 1010/15 per ASTM A569/A1011 grade 36 or higher for 68 degree stairs over 12 vertical feet.
 - 5. Handrails: 1 1/2" OD x 0.095" AISI 1010/15 CS per ASTM A569/A1011 cold drawn, fully annealed tube per ASTM A513 grade 1008 or higher As-welded tubing or ASTM A500 Grade B.
- K. Fasteners
 - 1. Bolts: handrail to stringer; Hex Head SAE J429 Grade 5, 1/2" Φ x 13 TPI
 - 2. Landing to structure; Carriage Head A307 or Hex Head SAE J429 Grade 5, 1/2" Φ x 13 TPI
 - 3. Nuts: ASTM A563 Grade 0
 - 4. Washers ASTM F844
- L. Miscellaneous Material:
 - 1. Rubber Spine: Hollow neoprene
 - 2. Rubber Foot Divider: Solid neoprene
- M. Finish: Safety Yellow Paint: Polyester TGIC* Powder Coat
- N. Fabrication:
 - 1. General: Fabricate alternating tread steel stairs to conform with performance and construction requirements, and in accordance with approved shop drawings or dimensional prints. Fabricate and shop-assemble to greatest extent possible.
 - 2. Carbon Steel: gas metal arc welded with treads spot welded to stringers and bolt-on handrails with included bolts using the specified materials.

2.10 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.11 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
- B. Prime bollards with zinc-rich primer.

2.12 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from cast aluminum in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
 - 1. Outlet: Vertical, to discharge into pipe.

2.13 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.14 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.15 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M 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 railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING ALTERNATING TREAD STAIR

- A. Preparations:
 - 1. Coordination: Coordinate start and installation of steel alternating tread stair with all other related and adjacent work. Installation shall not start until the construction has progressed to the point that weather conditions and remaining construction operations will not damage alternating tread stair installation.
 - 2. Verification: Verify that dimensions and angle are correct and that substrate is in proper condition for alternating tread stair installation. Do not proceed with installation until all necessary corrections have been made.
- B. Installation:
 - 1. If bumper has not been installed at the factory, install the bumper in accordance with the manufacturer's instructions (peel and stick).
 - 2. Prepare mounting holes.
 - 3. Position alternating tread stair with top tread at same elevation as upper finished floor or roof surface.
 - 4. Secure alternating tread stair with not less than 2 bolts or studs at top and with not less than 2 at bottom of stair.
 - 5. Touch up with matching paint any chipped or abraded damage to factory finish.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for operable partitions and overhead doors securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.4 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

- C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preassembled steel stairs with concrete-filled treads.
 - 2. Steel tube railings and guards attached to metal stairs.
 - 3. Steel tube handrails attached to walls adjacent to metal stairs.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, railings, and guards.
 - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
 - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
 - 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
 - 3. Include plan at each level.
 - 4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Environmental product declaration.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to $L/360$ or $1/4$ inch, whichever is less.

B. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.

- c. Uniform and concentrated loads need not be assumed to act concurrently.
- 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Seismic Performance of Stairs: Metal stairs withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing for Railings and Guards: ASTM A500/A500M (cold formed) or ASTM A513/A513M.
- D. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

2.3 ABRASIVE NOSINGS

- A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.
 - 2. Provide solid-abrasive units without ribs.
 - 3. Nosings, Square-Back Units: 3 inches wide, without lip.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

2.4 FASTENERS

- A. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.
- D. Prefilled Concrete Treads:
 - 1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi and maximum aggregate size of 1/2 inch unless otherwise indicated.
 - 2. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, steel, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated on Drawings.
 - 3. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.
 - a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.
- E. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings and guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 2. Locate joints where least conspicuous.
 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 4. Provide weep holes where water may accumulate internally.

2.7 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Service Class, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Stringers: Fabricate of steel channels as indicated on Drawings.
 - a. Stringer Size: As indicated on Drawings.
 - b. Provide closures for exposed ends of channel and rectangular tube stringers.
 - c. Finish: Shop primed.
 2. Platforms: Construct of steel plate or steel channel headers and miscellaneous framing members as indicated on Drawings.
 - a. Provide closures for exposed ends of channel and rectangular tube framing.
 - b. Finish: Shop primed.
 3. Weld stringers to headers; weld framing members to stringers and headers.
 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
1. Fabricate treads and landing subplatforms of exterior stairs so finished walking surfaces slope to drain.
 2. Steel Sheet, Uncoated: Cold-rolled steel sheet.
 3. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 4. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
 5. Shape metal pans to include nosing integral with riser.
 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.8 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
- B. Welded Connections: Fabricate railings and guards with welded connections.
1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 2. Weld all around at connections, including at fittings.
 3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 4. Obtain fusion without undercut or overlap.
 5. Remove flux immediately.
 6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint as shown in NAAMM AMP 521.
- C. Form changes in direction of railings and guards as follows:
1. As detailed.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing and guard members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Connect posts to stair framing by direct welding unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.
 - a. Clean bottom surface of plates.
 - b. Set plates for structural members on wedges, shims, or setting nuts.
 - c. Tighten anchor bolts after supported members have been positioned and plumbed.
 - d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 3. Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
 4. Secure posts, rail ends, and guard ends to building construction as follows:
 - a. Anchor posts to steel by welding to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 2. Secure wall brackets to building construction as required to comply with performance requirements.

3.4 REPAIR

- A. Touchup Painting:

1. 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 to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 055113

SECTION 061000 - ROUGH CARPENTRY

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. Wood blocking and nailers.
 - 2. Wood sleepers.
 - 3. Utility shelving.
 - 4. Plywood backing panels.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 QUALITY ASSURANCE

- A. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.

2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.5 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- C. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

- D. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use copper naphthenate for items not continuously protected from liquid water.
- E. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

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. Wall sheathing.
 - 2. Parapet sheathing.
 - 3. Sheathing joint and penetration treatment.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
- B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.
 - 1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
 - 2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.
- C. Sustainable Design Submittals:
 - 1. Product Data: For installation adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
 - 1. Type and Thickness: Type X, 5/8 inch thick.
 - 2. Size: 48 by 96 inches for vertical installation.

2.3 PARAPET SHEATHING

- A. Plywood Sheathing: , Exterior, Structural I sheathing.
 - 1. Span Rating: Not less than 16/0.
 - 2. Nominal Thickness: Not less than 1/2 inch.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 - 2. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.

- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Roof Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions and the following:
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

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. Plastic-laminate-clad architectural cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show large-scale details.
 - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- C. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
 - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.

- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- E. Samples for Initial Selection: For each type of exposed finish.
- F. Samples for Verification: For the following:
 - 1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
 - a. Provide one sample applied to core material with specified edge material applied to one edge.
 - 2. Corner Pieces:
 - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
 - b. Miter joints for standing trim.
 - 3. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of product.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.
- B. Architectural Woodwork Standards Grade: Premium.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
 - 1. Reveal Dimension: 1/2 inch.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Formica Corporation. (Basis of Design: Deco-Metal)
 - 2) Pionite; a Panolam Industries International, Inc. brand.
 - 3) Wilsonart LLC.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Vertical Surfaces: Grade VGS.
 - 3. Edges: PVC edge banding with radiused edges, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - 4. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- G. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS Thermoset decorative panels.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding with radiused edges, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - 2. Drawer Sides and Backs: Solid-hardwood lumber.
 - 3. Drawer Bottoms: Hardwood plywood.

- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.
 - 3. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Particleboard: ANSI A208.1, Grade M-2.
 - 2. Softwood Plywood: DOC PS 1.
 - 3. Recycled Content of MDF and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
 - 4. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Back-Mounted Pulls: BHMA A156.9, B02011.

- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Shelf Rests: BHMA A156.9, B04013; plastic two-pin plastic with shelf hold-down clip.
- F. Drawer Slides: BHMA A156.9.
 - 1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.
 - a. Type: Full extension.
 - b. Material: Epoxy-coated steel with polymer rollers.
 - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1HD-100.
 - 4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
 - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
- G. Door Locks: BHMA A156.11, E07121. Provide one per door.
- H. Drawer Locks: BHMA A156.11, E07041. Provide one per drawer.
- I. Door and Drawer Silencers: BHMA A156.16, L03011.
- J. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Color: Black.
 - 2. Provide 1 per 4'-0" of counter.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Stainless Steel: BHMA 630.
- L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
 - 2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 071113 - BITUMINOUS DAMPPROOFING

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. Cold-applied, emulsified-asphalt dampproofing.

1.3 ACTION SUBMITTALS

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

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Trowel Coats: ASTM D 1227, Type II, Class 1.
- B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- D. VOC Content: Zero.

2.2 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
 - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
 - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
 - 2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.
- B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat.
- C. Masonry Backup for Brick Veneer Assemblies: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..
- D. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft..

3.5 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 072100 - 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. Foam-plastic board insulation.
 - 2. Glass-fiber blanket insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 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 before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.
- B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- C. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
- D. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. DiversiFoam Products.
 - 2. Dow Chemical Company (The).
 - 3. Owens Corning, Formular High-R CW Plus (Basis of Design)
 - 4. Type IV, 25 psi, 1.55 pcf density.
 - 5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville; a Berkshire Hathaway company.
 - 3. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: 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. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing 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 indicated.
- 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. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
- 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 042000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber or Mineral-Wool 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.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 - 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

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 072100

SECTION 072500 - WEATHER BARRIERS

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. Building wrap.

1.3 ACTION SUBMITTALS

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

- 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

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

- a. Dow Chemical Company (The).
- b. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
- c. Ludlow Coated Products.
- d. Reemay, Inc.

- 2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
- 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
- 4. Allowable UV Exposure Time: Not less than three months.
- 5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

END OF SECTION 072500

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

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. Standing-seam metal roof panels.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified NC Professional Engineer, using performance requirements and design criteria indicated.
- C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft..
- D. Water Penetration: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- G. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Fire/Windstorm Classification: Class 1A-90.
 2. Hail Resistance: MH.
- H. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Wind speed as indicated on Drawings.
 2. Snow Loads: Load indicated on Drawings.
 3. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/240 of the span.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- J. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.
- K. Energy Performance: Provide roof panels that are listed on the U.S. Department of Energy's ENERGY STAR Roof Products Qualified Product List for steep-slope roof products.
- L. Energy Performance: Provide roof panels with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC-1.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 3. Accessories: 12-inch-long Samples for each type of accessory.
- E. Delegated-Design Submittal: For metal roof panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installers of the items involved:
1. Roof panels and attachments.
 2. Purlins and rafters.
 3. Roof-mounted items including bar joists, pipe and penetrations, and snow guards.
- B. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.
1. Submit evidence of meeting performance requirements.
- C. Qualification Data: For qualified Installer.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- E. Field quality-control reports.
- F. Warranties: Samples of special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal roof panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of metal roof panels from single source from single manufacturer.
- C. Surface-Burning Characteristics: Provide metal roof panels having insulation core material with the following surface-burning characteristics as determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- D. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
4. Examine deck substrate conditions for compliance with requirements, including flatness and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
8. Review temporary protection requirements for metal roof panel assembly during and after installation.
9. Review roof observation and repair procedures after metal roof panel installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.
- E. Protect foam-plastic insulation as follows:
 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.11 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Project Acceptance.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel 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 Project Acceptance.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: 20 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Energy Performance:
 - 1. Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for steep-slope roof products.
 - 2. Provide roof panels according to one of the following when tested according to CRRC-1:
 - a. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
 - b. Three-year, aged Solar Reflectance Index of not less than 64 when calculated in accordance with ASTM E1980.

- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).
- E. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.
- F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- G. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A- 105.
 - 2. Hail Resistance: MH.
- H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 FIELD-INSTALLED THERMAL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60-lb/cu. ft. minimum density unless otherwise indicated; with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively. Insulation shall comply with Underwriters Laboratories (UL) Inc. Roof Deck Construction #457, tested in accordance with ANSI/UL Standard 1256. This application requires that the insulation be capable of spanning across rib openings in the deck and provide reasonable resistance to foot traffic and other normal roof loads.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: 30 to 40 mils thick minimum, 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.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc., Div. of Carlisle Companies Inc.; CCW WIP 300HT.
 - b. Grace Construction Products; a unit of Grace, W. R. & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS METAL FRAMING

- A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.
- B. Cold-Rolled Furring Channels: Minimum 1/2-inch-wide flange.
 1. Nominal Thickness: As required to meet performance requirements.
 2. Depth: As required.
 3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with nominal thickness of 0.040 inch.
 4. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- C. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
 1. Nominal Thickness: 0.025 inch.
- D. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.5 MISCELLANEOUS MATERIALS

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching

panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: Subject to compliance with requirements and ability to match existing building, provide Construction Metals Products or comparable product by one of the following:
 - a. AEP-Span.
 - b. Berridge Manufacturing Company.
 - c. Merchant & Evans.
 - d. Construction Metal Products, Inc.
 - e. Metal Roofing System, Inc.
2. Material: Zinc-coated (galvanized) steel sheet, 24 gauge nominal thickness.
 - a. Exterior Finish: 2-coat fluoropolymer.
 - b. Color: As selected from Manufacturer's full range of colors including metallic and silver grays to match adjacent roofs.
3. Batten: Same material, finish, and color as roof panels.
4. Clips: Floating to accommodate thermal movement.
 - a. Material: 0.064-inch-nominal thickness, zinc-coated (galvanized) steel sheet.
5. Joint Type: Double folded.
6. Panel Coverage: 16 inches.
7. Panel Height: 2.0 inches.

2.7 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.8 ACCESSORIES

- A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.018 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.
- C. Gutters: Formed from same material roof panels. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- D. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual". Finish downspouts to match gutters.

2.9 FABRICATION

- A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 5. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.10 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. 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, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
- B. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
- C. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- D. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- E. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Substrate Board: Install substrate boards over roof deck on entire roof surface. Attach with substrate-board fasteners.
 - 1. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
- C. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over entire roof area, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

- B. Apply slip sheet over underlayment before installing metal roof panels.
- C. Install flashings to cover underlayment to comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

3.4 THERMAL INSULATION INSTALLATION

- A. Board Insulation: Extend insulation in thickness indicated to cover entire roof. Comply with installation requirements in Division 07 Section "Thermal Insulation."
 - 1. Erect insulation and hold in place with Z-shaped furring members spaced 24 inches o.c. Securely attach narrow flanges of furring members to roof deck with screws spaced 24 inches o.c.

3.5 METAL ROOF PANEL INSTALLATION, GENERAL

- A. Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
- B. Thermal Movement. Rigidly fasten metal roof panels to structure at one and only one location for each panel. Allow remainder of panel to move freely for thermal expansion and contraction. Predrill panels for fasteners.
 - 1. Point of Fixity: Fasten each panel along a single line of fixing located at eave
 - 2. Avoid attaching accessories through roof panels in a manner that will inhibit thermal movement.
- C. Install metal roof panels as follows:
 - 1. Commence metal roof panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
 - 2. Field cutting of metal panels by torch is not permitted.
 - 3. Install panels perpendicular to purlins.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Provide metal closures at rake edges, rake walls and each side of ridge and hip caps.
 - 6. Flash and seal metal roof panels with weather closures at eaves, rakes, and perimeter of all openings.
 - 7. Install ridge and hip caps as metal roof panel work proceeds.
 - 8. End Splices: Locate panel end splices over, but not attached to, structural supports. Stagger panel end splices to avoid a four-panel splice condition.
 - 9. Install metal flashing to allow moisture to run over and off metal roof panels.
- D. Fasteners:
 - 1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized-steel fasteners for surfaces exposed to the interior.
- E. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- F. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
 - 1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.6 METAL SOFFIT PANEL INSTALLATION

- A. In addition to complying with requirements in "Metal Roof Panel Installation, General" Article, install metal soffit panels to comply with requirements in this article.
- B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
 - 1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.
- C. Metal Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fascia meet soffits, along lower panel edges, and at perimeter of all openings.

3.7 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

- D. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - FORMED METAL WALL PANELS

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. Exposed-fastener, lap-seam metal wall panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal panel assembly during and after installation.
 - 8. Review of procedures for repair of metal panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
 - C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
 1. Include Samples of trim and accessories involving color selection.
 - D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
 - C. Field quality-control reports.
 - D. Sample Warranties: For special warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For metal panels to include in maintenance manuals.
- 1.7 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
 - C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockup of typical metal panel assembly as shown on Drawings, including corner, supports, attachments, and accessories.
 2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Project Acceptance.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel 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 Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and between major ribs.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Metal Systems.
 - b. Berridge Manufacturing Company.
 - c. Fabral.
 - d. MBCI.
 - e. McElroy Metal, Inc.
 - f. PAC-CLAD; Petersen Aluminum Corporation.
 - g. Construction Metal Products, Inc.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

- a. Nominal Thickness: 0.034 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
3. Major-Rib Spacing: 7.2 inches o.c.
 4. Panel Coverage: 36 inches.
 5. Panel Height: 1.5 inches.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
 - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 - 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 - 5. Flash and seal panels with weather closures at perimeter of all openings.
- E. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 - 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 074243 - METAL COMPOSITE MATERIAL WALL PANELS

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 metal composite material wall panels.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
 - 8. Review procedures for repair of panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.
 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build mockup of typical metal composite material panel assembly 48" x 48", including corner, soffits, supports, attachments, and accessories.
 2. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Project Acceptance.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel 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 Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

- A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alcoa Architectural Products (USA).
 - b. Alcotex Inc.
 - c. ALUCOBOND; 3A Composites USA, Inc. (BASIS FOR DESIGN)
 - d. CENTRIA Architectural Systems.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, anodized aluminum sheet facings.
 - 1. Panel Thickness: 0.157 inch.
 - 2. Core: Standard.
 - 3. Exterior Finish:
 - a. Clear anodized unless noted otherwise on Drawings.
 - b. Painted alternating bands of the following:
 - 1) Natural Collection- Chestnut.
 - 2) Natural Collection- Rustic Walnut.

- C. Attachment Assembly Components: Formed from extruded aluminum.
- D. Attachment Assembly: Subgirt and spline.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

2.4 FABRICATION

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Anodized Aluminum Finish: Clear in accordance with AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- D. Coil-Coated Metal Finish (Manufacturer's Option):
 1. PVDF Fluoropolymer: AAMA 2605, two-coat minimum fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. FEVE Fluoropolymer: AAMA 2605, two-coat fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

- B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
2. Copper Panels: Use copper, stainless-steel or hardware-bronze fasteners.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.

3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.
- F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-turned flanges of wall panels to panel clips with manufacturer's standard fasteners.
1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
 2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- G. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use manufacturer's standard horizontal tracks and vertical drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach metal composite material wall panels to tracks by interlocking panel edges with manufacturer's standard "T" clips.
1. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
 2. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
 3. Do not apply sealants to joints unless otherwise indicated.
- H. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.
- I. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.
- C. Metal composite material wall panels will be considered defective if they do not pass test and inspections.
- D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074243

SECTION 074293 - METAL SOFFIT PANELS

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 metal soffit panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Project Acceptance.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel 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 Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match profile and material of metal roof panels.
 - 1. Finish: Match finish and color of metal roof panels.
 - 2. Sealant: Factory applied within interlocking joint.

- C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
1. Material: Same material, finish, and color as metal roof panels.
 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.022 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: As selected by Architect from manufacturer's full range.
 3. Panel Coverage: 12 inches.
 4. Panel Height: 1.0 inch.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 - 1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
 - 2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 - 1. Soffit Framing: Wire tie or clip furring channels to supports.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Watertight Installation:
 - 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 - 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-slope roof sheet metal fabrications.

B. Related Requirements:

1. Section 074113 "Standing-Seam Metal Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.
2. Section 074243 "Metal Composite Material Wall Panels" for sheet metal flashing and trim integral with metal wall panels.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.**

- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.**

1.3 PREINSTALLATION MEETINGS

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

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following**

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

- B. Shop Drawings: For sheet metal flashing and trim.**

1. Include plans, elevations, sections, and attachment details.

2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of roof-penetration flashing.
 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
 12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.
- D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 1. Build mockup of typical roof edge, including fascia, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 coating designation, Grade 40; prepainted by coil-coating process to comply with ASTM A755/A755M.
 1. Surface: Smooth, flat.
 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 3. Color: As selected by Architect from manufacturer's full range including metallics.
 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 1. Source Limitations: Obtain underlayment from single source from single manufacturer.
 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Not permitted.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - D. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
 - E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
 - F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
 - G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
 - 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
 - 3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters:
 - 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
 - 2. Fabricate in minimum 96-inch-long sections.
 - 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
 - 4. Gutter Profile: As indicated.
 - 5. Expansion Joints: Butt type with cover plate.
 - 6. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.050 inch thick.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
 - 1. Fabricated Hanger Style: As indicated. in accordance with SMACNA's "Architectural Sheet Metal Manual."
 - 2. Fabricate from the following materials: Same as gutter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
 - 1. Join sections with joints sealed with sealant.
 - 2. Provide for thermal expansion.
 - 3. Attach gutters at eave or fascia to firmly anchor them in position.
 - 4. Provide end closures and seal watertight with sealant.
 - 5. Slope to downspouts.
 - 6. Fasten gutter spacers to front and back of gutter.
 - 7. Anchor and loosely lock back edge of gutter to continuous cleat.
 - 8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 - 9. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
 - 10. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts:
 - 1. Join sections with 1-1/2-inch telescoping joints.
 - 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 - 3. Locate hangers at top and bottom and at approximately 60 inches o.c.
 - 4. Provide elbows at base of downspout to direct water away from building.
 - 5. Connect downspouts to underground drainage system.

3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077253 - SNOW GUARDS

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. Rail-type, seam-mounted snow guards.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
- B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
 - 1. Include details of rail-type snow guards.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Structural Performance:
 - 1. Snow Loads: As indicated on Drawings.

2.2 RAIL-TYPE SNOW GUARDS

- A. Seam-Mounted, Rail-Type Snow Guards:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
 - b. S-5! Attachment Solutions; Metal Roof Innovations, Ltd.

- c. Snow Management Systems.
 - d. TRA SNOW & SUN, INC.
- 2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with the number and type of rails to match the existing roof.
 - 3. Material and Finish: Stainless steel; Match roofing panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
 - 1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare substrates for bonding snow guards.
- B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

- A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.
- B. Attachment for Standing-Seam Metal Roofing:
 - 1. Do not use fasteners that will penetrate metal roofing, or fastening methods that void metal roofing finish warranty.
 - 2. Seam-Mounted, Rail-Type Snow Guards: Stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

END OF SECTION 077253

SECTION 078413 - 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
- C. Sustainable Design Submittals:
 - 1. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

- a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
- b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

B. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
 1. Verify sealant has a VOC content of 250 g/L or less.
- D. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. 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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.

2.2 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. 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.
- G. 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.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.3 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping 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: Clean out openings immediately before installing penetration firestopping 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.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: 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.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping 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 fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping 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 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 is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078443 - 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 in smoke barriers.

1.3 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.
- C. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

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

1.6 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."

1.7 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.

1.8 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."

2.2 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. 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 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.
 - 1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
 - 1. Verify sealant has a VOC content of 250 g/L or less.
- E. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- F. 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 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.5 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.

3.6 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 Substantial Completion. 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 078443

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Immersible joint sealants.
 - 5. Silyl-terminated polyether joint sealants.
 - 6. Mildew-resistant joint sealants.
 - 7. Polysulfide joint sealants.
 - 8. Butyl joint sealants.
 - 9. Latex joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. 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 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.5 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.

1.6 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 Project 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 Project 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 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
- B. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
- C. Silicone, S, P, 100/50, T, NT: Single-component, pourable, plus 100 percent and minus 50 percent movement capability traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 100/50, Uses T and NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.6 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.

2.7 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.

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.
 - c. Unglazed surfaces of ceramic tile.
 - 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. Porcelain enamel.
 - d. 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 all locations according to Figure 8B in ASTM C 1193.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:

- a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 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.

3.6 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 Substantial Completion. 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.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 1. Joint Locations:

- a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, S, P, 50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between metal panels.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - e. Control and expansion joints in ceilings.
 - f. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
- 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, S, P, 100/50, T, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of unit masonry, walls and partitions.
 - d. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, S, NS, 50, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
- 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Acrylic latex.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Around perimeter of floors, ceiling, and doors, in Clean Room, Dressing, and DCON.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, P, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.

1.2 DEFINITIONS

- ##### A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- ##### A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- ##### B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule on Drawings.
- b. Thickness: 1-3/4 inches.
- c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
- d. Edge Construction: Model 1, Full Flush.
- e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches.
- f. Core: Manufacturer's standard.
- g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.

2. Frames:

- a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
- b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.3 FRAME ANCHORS

A. Jamb Anchors:

- 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
- 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
- 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

- 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081213 - HOLLOW METAL FRAMES

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 hollow-metal frames.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 2. Locations of reinforcement and preparations for hardware.
 - 3. Details of each different wall opening condition.
 - 4. Details of anchorages, joints, field splices, and connections.
 - 5. Details of moldings, removable stops, and glazing.
 - 6. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of frame assembly, for tests performed by a qualified testing agency.

- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each unit to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR FRAMES

- A. Construct interior frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Hollow-Metal Frames: NAAMM-HMMA 860..
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - 3. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 1. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
- 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
- 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames.
 - 3. Provide loose stops and moldings on inside of hollow-metal work.
 - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
- 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 3. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081416 - FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
 - 2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.
 - b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
 - 3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lambton Doors
 - 2. Oregon Doors
 - 3. Masonite Architectural
 - 4. VT Industries
 - 5. Oshkosh Door Company.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
 - 1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 - 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Species: Select white birch.
 - 3. Cut: Rotary cut.
 - 4. Match between Veneer Leaves: Book match.
 - 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 - 7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
 - 8. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - 9. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
 - 10. Core: Glued wood stave.
 - 11. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 - 12. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

- A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 9, UV curable, acrylated epoxy, polyester, or urethane System 11, catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Filled finish.
 - 5. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - b. 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083323 - OVERHEAD COILING DOORS

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. Insulated service doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 - 5. Show locations of controls, locking devices, and other accessories.
 - 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Curtain slats, including full vision window secured to slat.
 - 2. Bottom bar.
 - 3. Guides.
 - 4. Brackets.

5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 1. Design Wind Load: As indicated on Drawings.
 2. Testing: According to ASTM E330/E330M.

3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ACME Rolling Doors.
 - b. Clopay Building Products.
 - c. Cookson Company.
 - d. Overhead Door Corporation.
 - e. Raynor.
 - f. Wayne-Dalton Corp.
- B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.
- D. STC Rating: 26.
- E. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- F. Door Curtain Material: Stainless steel.
- G. Door Curtain Slats: Curved profile slats of 1-7/8-inch center-to-center height.
 1. Vision Panels: Approximately 10- by 1-5/8-inch openings spaced approximately 2 inches apart and beginning 12 inches from end guides; in two rows of slats at height indicated on Drawings; installed with insulated vision-panel glazing.
 2. Insulated-Slat Interior Facing: Metal.
 3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from stainless steel and finished to match door.
- I. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.
- J. Hood: Match curtain material and finish.
 1. Shape: Square.
 2. Mounting: Face of wall.
- K. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside and outside with cylinders.

L. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
2. Operator Location: Top of hood or Front of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
4. Motor Exposure: Exterior, wet, and humid.
5. Motor Electrical Characteristics:
 - a. Horsepower: 1 hp.
 - b. Voltage: 115-V ac, single phase, 60 Hz.
6. Emergency Manual Operation: Push-up type.
7. Obstruction-Detection Device: Automatic pneumatic sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: Black.
8. Control Station(s):
 - a. Interior mounted activated with push button open doors.

M. Curtain Accessories: Equip door with weatherseals, push/pull handles.

N. Door Finish:

1. Stainless Steel Finish: ASTM A480/A480M No. 4 (polished directional satin).
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Stainless Steel Door Curtain Slats: ASTM A666, Type 304; sheet thickness of 0.025 inch; and as required.
 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Stainless Steel: 0.025-inch-thick, stainless steel sheet, Type 304, complying with ASTM A666.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
 - 1. Keys: Three for each cylinder.
- C. Chain Lock Keeper: Suitable for padlock.
- D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

- A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.
- B. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
 - 1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.9 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
 - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening.
 - 1. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 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.

2.12 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: ASTM A480/A480M No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 084213 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior framing.
 - 2. Exterior Aluminum FRP Doors.
 - 3. Exterior Aluminum Entrance Doors.

1.3 DEFINITIONS

- A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
 - 1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
 - 2. Dimensional tolerances of building frame and other adjacent construction.
 - 3. Failure includes the following:
 - a. Deflection exceeding specified limits.
 - b. Thermal stresses transferring to building structure.
 - c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
 - d. Glazing-to-glazing contact.
 - e. Noise or vibration created by wind and by thermal and structural movements.
 - f. Loosening or weakening of fasteners, attachments, and other components.
 - g. Sealant failure.
 - h. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings..
 - 2. Seismic Loads: As indicated on Drawings.

- C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite.
 2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span.
- D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.
- E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
- F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- G. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
1. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.
- H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 3. Interior Ambient-Air Temperature: 75 deg F.
- I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 > when tested according to AAMA 1503.
- J. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

K. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1. Sound Transmission Class (STC): Minimum 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
2. Outdoor-Indoor Transmission Class (OITC): Minimum 26 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 PERFORMANCE REQUIREMENTS- FRP Doors

- A. General: Provide door assemblies that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturer's corresponding standard systems.
- B. Indoor air quality testing per ASTM D 6670-01: GREENGUARD Environmental Institute Certified including GREENGUARD for Children and Schools Certification.
- C. Impact Strength, AMP Doors and Panels, Nominal Value, ASTM D 256: 2.6 foot-pounds per inch of notch.
- D. Tensile Strength, AMP Doors and Panels, Nominal Value, ASTM D 638: 7,500 psi.
- E. Flexural Strength, AMP Doors and Panels, Nominal Value, ASTM D 790: 16,900 psi.
- F. Water Absorption, AMP Doors and Panels, Nominal Value, ASTM D 570: 0.63 percent after 24 hours.
- G. Indentation Hardness, AMP Doors and Panels, Nominal Value, ASTM D 2583: 38.
- H. Abrasion Resistance, Face Sheet, Taber Abrasion Test, 25 Cycles at 1,000 Gram Weight with CS-17 Wheel: Maximum of 0.022 average weight loss percentage.
- I. Compressive Strength, Foam Core, Nominal Value, ASTM D 1621: 79.9 psi.
- J. Compressive Modulus, Foam Core, Nominal Value, ASTM D 1621: 370 psi.
- K. Tensile Adhesion, Foam Core, Nominal Value, ASTM D 1623: 45.3 psi.
- L. Thermal and Humid Aging, Nominal Value, 158 Degrees F and 100 Percent Humidity for 14 Days, ASTM D 2126: Minus 5.14 percent volume change.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.
- B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
 2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:
 1. Joinery, including concealed welds.
 2. Anchorage.
 3. Expansion provisions.
 4. Flashing and drainage.

- F. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project. All design and shop drawings to be signed and sealed by a NC Professional Engineer.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and the NC Accessibility Code Volume I-C.
- F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration caused by thermal movements.

- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Adhesive or cohesive sealant failures.
 - e. Water leakage through fixed glazing and framing areas.
 - f. Failure of operating components.
2. Warranty Period: Ten years from date of Project Acceptance.
- B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following for Aluminum doors and storefront:
- 1. Commercial Architectural Products, Inc.
 - 2. EFCO Corporation; (Basis for Design, 433T Storefront Framing (U.N.O.), D300 Aluminum Entrance Doors, and 402 Storefront at Mechanical Room doors)
 - 3. Kawneer North America; an Alcoa company.
 - 4. United States Aluminum.
 - 5. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
 - 6. YKK AP America Inc.
 - 7. Special-Lite (Basis for Design FRP Doors)

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.
- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
- 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: As indicated.
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.
- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
 - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 ALUMINUM ENTRANCE DOOR SYSTEMS

- A. General: Major portions of the door sections shall have .125" (3 mm) wall thickness. Glazing stop sections shall have .050" (1.2 mm) wall thickness.
- B. Entrance Doors: Door stiles shall be no less than 6" wide (not including glass stops).
- C. Door stiles and rails shall have hairline joints at corners. Heavy concealed reinforcement brackets shall be secured with screws and shall be of deep penetration and fillet welded.
- D. All doors shall have an adjusting mechanism in the top rail to provide for minor clearance adjustments.
- E. Weather stripping shall be wool pile and shall be installed in one stile of pairs of doors and in jamb stiles of center pivoted doors.
- F. Door stops shall include a bulb weather-strip that complies with ASTM E 2203 specification.
- G. Glazing: All units shall be dry glazed with extruded pressure fitting aluminum glazing stops, and a gasket that complies with ASTM E 2203 specification.
- H. Finish: Clear Anodic

2.5 FRP ENTRANCE DOOR SYSTEMS

- A. Model: SL-17 Flush Doors with SpecLite3 fiberglass reinforced polyester (FRP) face sheets
- B. Construction:
 - 1. Door Thickness: 1-3/4 inches.
 - 2. Stiles and Rails: Aluminum extrusions made from prime-equivalent billet that is produced from 100% reprocessed 6063-T5 alloy recovered from industrial processes, minimum of 2-5/16-inch depth.
 - 3. Corners: Mitered.
 - 4. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom integral to standard tubular shaped stiles and rails reinforced to accept hardware as specified
 - 5. Securing Internal Door Extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
 - 6. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
 - 7. Rail caps or other face sheet capture methods are not acceptable.
 - 8. Extrude top and bottom rail legs for interlocking continuous weather bar.
 - 9. Meeting Stiles: Pile brush weatherseals. Extrude meeting stile to include integral pocket to accept pile brush weatherseals.
 - 10. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded int locking edge of bottom rail.
 - 11. Glue: Use of glue to bond sheet to core or extrusions is not acceptable.
- C. Face Sheet:
 - 1. Material: SpecLite3 FRP, 0.120-inch thickness, finish color throughout.
 - 2. Protective coating: Abuse-resistant engineered surface. Provide FRP with SpecLite3 protective coating, or equal.
 - 3. Texture: Pebble.
 - 4. Color: As selected from full range of all available colors.
 - 5. Adhesion: The use of glue to bond face sheet to foam core is prohibited.
- D. Core:
 - 1. Material: Poured-in-place polyurethane foam.
 - 2. Density: Minimum of 5 pounds per cubic foot.
 - 3. R-Value: Minimum of 9.
- E. Cutouts:
 - 1. Manufacture doors with cutouts for required vision lites, louvers, and panels.
 - 2. Factory install vision lites, louvers, and panels.
- F. Hardware:
 - 1. Premachine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
 - 2. Factory install hardware.

2.6 ENTRANCE DOOR HARDWARE

- A. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

- B. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.7 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."
 - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
 - 6. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.
- E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

- A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
 - 1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
 - 2. Alignment:
 - a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
- B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.
- C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

END OF SECTION 084213

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

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 conventionally glazed aluminum curtain walls installed as stick assemblies.

1.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified NC Professional Engineer, using performance requirements and design criteria indicated.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
- D. Structural-Test Performance: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing.
 3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
- F. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
- G. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
1. Maximum Water Leakage: According to AAMA 501.1 Water leakage does not include water controlled by flashing and gutters that is drained to exterior.
- H. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
 2. Test Interior Ambient-Air Temperature: 75 deg F.
 3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- I. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft.
 4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC- certified condensation resistance rating of no less than as determined according to NFRC 500.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.

- c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
 - 1. Joinery, including concealed welds.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.
- F. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified NC Professional Engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Welding certificates.
- C. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.
- E. Field quality-control reports.
- F. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
- E. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. 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. Warranty Period: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide EFCO Series 5600 or comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. Kawneer Company, Inc.; Arconic Corporation.
 - 3. TRACO, a division of Kawneer.
 - 4. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Structural Profiles: ASTM B 308/B 308M.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

- B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard. Provide at all curtain wall verticals as required to maintain depth of frames as indicated on the Contract Drawings.
 - 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

- A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Front.

- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

- D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

- E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

- F. Framing Sealants: Manufacturer's standard sealants.

2.4 GLAZING

- A. Glazing: Comply with Division 08 Section "Glazing."

- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: Comply with Division 08 Section "Glazing."
 - 1. Sealants used inside the weatherproofing system shall have a VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 ACCESSORY MATERIALS

- A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components that, when assembled, have the following characteristics:
 - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Per specified manufacturer.
- F. Factory-Assembled Frame Units:
 - 1. Rigidly secure nonmovement joints.
 - 2. Seal joints watertight unless otherwise indicated.
 - 3. Install glazing to comply with requirements in Division 08 Section "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

- 1. Comply with manufacturer's written instructions.
- 2. Do not install damaged components.
- 3. Fit joints to produce hairline joints free of burrs and distortion.
- 4. Rigidly secure nonmovement joints.
- 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- 6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- 7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

- 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
- 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Division 08 Section "Glazing."

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

- 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
- 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
- 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.

- b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

- A. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
 - 1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- B. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum-framed assemblies incorporating fiberglass-sandwich panels as follows:
 - 1. Wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum components of panel assemblies.
- B. Shop Drawings: For panel assemblies.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
- C. Samples: In manufacturer's standard size.
 - 1. For each type of fiberglass-sandwich panel.
 - 2. For each type of exposed finish for framing members.
- D. Fabrication Samples: Of each framing system intersection and adjacent panels, made from 12-inch lengths of full-size framing members and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Fiberglass-sandwich panels.
 - 5. Flashing and drainage.
- E. Delegated Design Submittals: For panel assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified manufacturer.
- B. Product Test Reports: For each fiberglass-sandwich-panel assembly, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For fiberglass-sandwich-panel assemblies from ICC-ES.

- D. Field quality-control reports.
- E. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: For fiberglass-sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICC-ES AC04 or ICC-ES AC177.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Water leakage.
 - 2. Warranty Period: Five years from date of Project Acceptance.
- B. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace fiberglass-sandwich panels that exhibit defects in materials or workmanship within specified warranty period.
 - 1. Defects include, but are not limited to, the following:
 - a. Fiberbloom.
 - b. Delamination of coating, if any, from exterior face sheet.
 - c. Color change exceeding requirements.
 - d. Delamination of panel face sheets from panel cores.
 - 2. Warranty Period: 10 years from date of Project Acceptance.
- C. Special Aluminum-Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
 - 1. Failures include, but are not limited to, checking, crazing, peeling, chalking, and fading of finishes.
 - 2. Warranty Period: 20 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fiberglass-sandwich-panel assemblies.
- B. Structural Loads: As indicated on Drawings.
- C. Deflection Limits:
 - 1. Vertical Panel Assemblies: Limited to 1/120 of clear span for each assembly component.
- D. Structural-Test Performance: Provide panel assemblies tested in accordance with ASTM E330, as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not show evidence of deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not show evidence of material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Water Penetration under Static Pressure: Provide panel assemblies that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- F. Water Penetration under Dynamic Pressure: Provide panel assemblies that do not evidence water leakage through fixed glazing and framing areas when tested in accordance with AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- G. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- H. Energy Performance: Provide panel assemblies with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below and certified and labeled according to NFRC:
 - 1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas to have U-factor of not more than 0.80 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - 2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas to have a SHGC of no greater than 0.6 as determined in accordance with NFRC 200.
 - 3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined in accordance with ASTM E283 at a minimum static-air-pressure differential of 1.57 lbf/sq. ft..

2.2 FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

- A. Fiberglass-Sandwich-Panel Assemblies: Translucent assemblies that are supported by aluminum framing and glazed with fiberglass-sandwich panels.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kalwall Corporation (Basis of Design).
 - b. Centria
 - c. Crane Composites

2.3 FIBERGLASS-SANDWICH PANELS

- A. Fiberglass-Sandwich Panels: Uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core.
 - 1. Core Insulation: Fill panel cores with aerogel.
- B. Panel Thickness: 2-3/4 inches.
- C. Grid Core: Mechanically interlocked, extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.
 - 1. Extruded Aluminum: ASTM B221, in alloy and temper recommended in writing by manufacturer.
 - 2. I-Beam Construction: Thermally broken, extruded aluminum.
 - 3. Grid Pattern: As indicated on Drawings.
- D. Exterior Face Sheet:
 - 1. Thickness: 0.070 inch.
 - 2. Color: As selected by Architect from manufacturer's full range.
 - 3. Protective Weathering Surface: Manufacturer's standard.
- E. Interior Face Sheet:
 - 1. Thickness: 0.060 inch.
 - 2. Color: As selected by Architect from manufacturer's full range.
- F. Fiberglass-Sandwich-Panel Adhesive: Manufacturer's standard for permanent adhesion of facings to cores.
- G. Panel Strength:
 - 1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested in accordance with ASTM E72 at 34 lbf/sq. ft., with a maximum 0.090-inch set deflection after five minutes.
 - 2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch-diameter disk in accordance with ASTM E661.
- H. Panel Performance:
 - 1. Self-Ignition Temperature: 650 deg F or more in accordance with ASTM D1929.

2. Smoke-Developed Index: 450 or less in accordance with ASTM E84, or 75 or less in accordance with ASTM D2843.
3. Combustibility Classification: Class CC1 based on testing in accordance with ASTM D635.
4. Interior Finish Classification: Class A based on testing in accordance with ASTM E84.
5. Color Change: Not more than 3.0 units Delta E, when measured in accordance with ASTM D2244, after outdoor weathering compliant with procedures in ASTM D1435.
 - a. Outdoor Weathering Conditions: Sixty months in southern Florida.
6. Impact Resistance: No fracture or tear at impact of 60 ft. x lbf by a 3-1/4-inch-diameter, 5-lb freefalling ball in accordance with UL 972 test procedure.
7. Haze Factor: Greater than 90 percent when tested in accordance with ASTM D1003.

2.4 ALUMINUM FRAMING SYSTEMS

- A. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Thermally broken, extruded aluminum.
- B. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B209.
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
 3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
 4. Structural Profiles: ASTM B308/B308M.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.
- D. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding fasteners and accessories; compatible with adjacent materials.
 1. At closures, retaining caps, or battens, use ASTM A193/A193M, 300 series stainless steel screws.
 2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.
- E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- F. Anchor Bolts: ASTM A307, Grade A, galvanized steel.
- G. Concealed Flashing: Corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- H. Exposed Flashing and Closures: Aluminum sheet not less than 0.050 inch thick, finished to match framing.
- I. Framing Gaskets: Manufacturer's standard.
- J. Frame-System Sealants: As recommended in writing by manufacturer.

- K. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

A. Frame System Fabrication:

1. Fabricate components that, when assembled, have the following characteristics:
 - a. Profiles that are sharp, straight, and free of defects or deformations.
 - b. Accurately fitted joints with ends coped or mitered.
 - c. Internal guttering systems or other means to drain water passing through joints, and moisture migrating within assembly to exterior.
2. Fabricate sill closures with weep holes and for installation as continuous component.
3. Reinforce components as required to receive fastener threads.

B. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
 - a. White spots indicating lack of bond at intersections of grid-core members are limited in number to four for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.
2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
 1. Do not install damaged components.
 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
 3. Rigidly secure nonmovement joints.

4. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and immobilization of moving joints.
 5. Seal joints watertight unless otherwise indicated.
- B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with corrosion-resistant coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.
- C. Install components plumb and true in alignment with established lines and elevations.
- D. Erection Tolerances: Install panel assemblies to comply with the following maximum tolerances:
1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
 2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet, but no greater than 1/2 inch over total length.
- 3.3 FIELD QUALITY CONTROL
- A. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.
 - B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - C. Prepare test and inspection reports.

END OF SECTION 084523

SECTION 085113 - ALUMINUM WINDOWS

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 aluminum windows for exterior locations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches in size.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
 - 1. Include similar Samples of hardware and accessories involving color selection.
- E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
 - 1. Exposed Finishes: 2 by 4 inches.
 - 2. Exposed Hardware: Full-size units.
- F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.
- B. **Installer Qualifications:** An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- C. **Mockups:** Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
 - c. Faulty operation of movable sash and hardware.
 - d. Deterioration of materials and finishes beyond normal weathering.
 - e. Failure of insulating glass.
 - 2. **Warranty Period:**
 - a. Window: 10 years from date of Project Acceptance.
 - b. Glazing Units: 10 years from date of Project Acceptance.
 - c. Aluminum Finish: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide **EFCO 325G** or a comparable product by one of the following:
 - 1. EFCO Corporation.
 - 2. Graham Architectural Products Corp.
 - 3. Kawneer; an Alcoa Company.
 - 4. TRACO.
 - 5. YKK AP America Inc.
- B. **Source Limitations:** Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
 - 1. Window Certification: AMMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
 - 1. Minimum Performance Class: AW.
 - 2. Minimum Performance Grade: 80.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 74.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.
- G. Sound Transmission Class (STC): Rated for not less than 36 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

2.3 ALUMINUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:
 - 1. Fixed.
- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- C. Insulating-Glass Units: Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
- D. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- B. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
 - 1. Angled mullion posts with interior and exterior trim.
 - 2. Angled interior and exterior extension and trim.
 - 3. Exterior head and sill casings and trim.
- H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are

not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
 2. Air-Infiltration Testing:
 - a. Test Pressure: That required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance class indicated.
 - b. Allowable Air-Leakage Rate: 1.5 times the applicable AAMA/WDMA/CSA 101/I.S.2/A440 rate for product type and performance class rounded down to one decimal place.
 3. Water-Resistance Testing:
 - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
 - b. Allowable Water Infiltration: No water penetration.
 4. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
 5. Test Reports: Prepared according to AAMA 502.
- C. Remove and replace noncomplying windows and retest as specified above.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

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. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Electrified door hardware.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
- B. Keying Conference: Conduct conference at Project site.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.

- e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For each type of exposed product, in each finish specified.
 - 1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
 - 2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 - 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.

- h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
 - 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Project Acceptance unless otherwise indicated below:
 - a. Manual Closers: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/4 inch high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled in Part 3.

2.4 HINGES

- A. Hinges: BHMA A156.1.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Baldwin Hardware Corporation.
 - c. Hager Companies.
 - d. McKinney Products Company; an ASSA ABLOY Group company.
 - e. PBB, Inc.

2.5 CONTINUOUS HINGES

- A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Hager Companies.
 - c. McKinney Products Company; an ASSA ABLOY Group company.
 - d. PBB, Inc.
 - e. Pemko Manufacturing Co.

f. Select Products Limited.

2.6 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 2. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: See Schedule.
 - 2. Levers: Cast.
 - 3. Escutcheons (Roses): Cast.
 - 4. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.
 - c. Yale

2.7 AUXILIARY LOCKS

- A. Mortise Auxiliary Locks: BHMA A156.36; Grade 1; with strike that suits frame.

2.8 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.

- b. Allegion plc.
- c. Door Controls International, Inc.
- d. Hager

2.9 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic Flush Bolts: BHMA A156.3, Type 25; minimum 3/4-inch throw; with dust-proof strikes; designed for mortising into door edge. Include wear plates.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
 - b. Allegion plc.
 - c. Door Controls International, Inc.
 - d. Hager

2.10 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - b. SARGENT Manufacturing Company; ASSA ABLOY.
 - c. Yale

2.11 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
- B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.12 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.

2.13 KEY CONTROL SYSTEM

- A. Key Lock Boxes: Designed for storage of 20 keys.

2.14 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Hager Companies.
 - c. Hiawatha, Inc; a division of the Activar Construction Products Group.

2.15 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.16 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
 - b. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
 - c. SARGENT Manufacturing Company; ASSA ABLOY.

2.17 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.18 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.19 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Pemko Manufacturing Co.
 - c. Reese Enterprises, Inc.
 - d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

2.20 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allegion plc.
 - b. Hager Companies.
 - c. Hiawatha, Inc; a division of the Activar Construction Products Group.
 - d. Pawling Corporation.

2.21 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the

door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.22 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other 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 doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings and to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
- E. Key Control System:
 - 1. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
- F. Boxed Power Supplies: Locate power supplies in equipment/data room access control panel. Verify location with Architect.
 - 1. Configuration: Provide centrally located (in Data Room) power supply with power supplies sized to operate all the electrified door hardware.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Project Acceptance.

3.6 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1

Exterior Aluminum Doors-Secured

2	Cont. Hinge (Electrified)	Hager, 14 GA	780-111HD-ETW	
2	Exit Device w/ELR	Corbin-Russwin	ED5200-MELR-08-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Automatic Door Operator	LCN 4690		630
2	HC Actuators (Wired)			
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Removable Mullion	Sargent	980	Alum.
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
2	Door Contacts	Provide all low-voltage wiring to location.		

Door Hardware Set No. 2

Exterior Aluminum Doors-Secured

2	Cont. Hinge (Electrified)	Hager, 14 GA	780-111HD-ETW	
2	Exit Device w/ELR	Corbin-Russwin	ED5200-MELR-08-ASM	630

2	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Removable Mullion	Sargent	980	Alum.
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
2	Door Contacts			

Door Hardware Set No. 3

Exterior Aluminum/FRP Doors

2	Cont. Hinges	Hager, 14 GA	780-111HD	304
2	Closers/Hold Opens	Corbin-Russwin	DC6210xA1 w/Hold-Open	689
1	Exit Device	Corbin-Russwin	ED5200-08-Storeroom	630
1	Exit Device	Corbin-Russwin	ED5200-08-Storeroom Less Exterior Hardware	630
1	Removable Mullion	Sargent	980	Alum.
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
2	Door Contact	Provide all low-voltage wiring to location.		

Door Hardware Set No. 4

Exterior Aluminum Doors-Secured- Exit Only

1	Cont. Hinges	Hager, 14 GA	780-11HD	304
1	Mortise Lockset-Entrance	Corbin-Russwin	ML2051-ASM-Exit Only	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Door Contact	Provide all low-voltage wiring to location.		

Door Hardware Set No. 4A

Exterior Aluminum Doors-Secured

1	Cont. Hinges (Electrified)	Hager, 14 GA	780-11HD-ETW	304
1	EC Mortise Lockset-Entrance	Corbin-Russwin	ML20903-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
1	Door Contact	Provide all low-voltage wiring to location.		

Door Hardware Set No. 5

Exterior Aluminum/FRP Doors

1	Cont. Hinges	Hager, 14 GA	780-111HD	304
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Mortise Lockset-Classroom	Corbin-Russwin	ML2055-ASM	630
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Door Contact	Provide all low-voltage wiring to location.		

Door Hardware Set No. 6

Exterior Aluminum/FRP Doors

1	Cont. Hinges	Hager, 14 GA	780-111HD	304
1	Closers/Hold Opens	Corbin-Russwin	DC6210xA1 w/Hold-Open	689
1	Mortise Lockset-Storage	Corbin-Russwin	ML2057-ASM-M25	630
1	Cylinder	Corbin Russwin		
1 set	Weatherstrip	By Alum. /FRP Manuf.		
1	Threshold	Pemko	2006-T	
1	Door Contact	Provide all low-voltage wiring to location.		

Door Hardware Set No. 9

Interior HM Doors & Metal Frame- Fire-rated

1.5	Pr. Hinges	Hager	HT BB1168, 4 1/2" x 4 1/2"	
1	Lockset - Passage	Corbin-Russwin	ML2010-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Kickplates	Hager, 12"x1"LDW		

Door Hardware Set No. 10

Interior Aluminum Doors

2	Cont. Hinge (Electrified)	Hager, 14 GA	780-111HD-ETW	
2	Exit Device w/ELR	Corbin-Russwin	ED5200-MELR-08-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Automatic Door Operator	LCN 4690		630
2	HC Actuators (Wired)			
1	Cylinder	Corbin Russwin		
1	Removable Mullion	Sargent	980	Alum.

Door Hardware Set No. 11

Interior Wood Doors & Metal Frame-Secured

0.5	Pr. Hinges (Electrified)	Hager	HT BB1168-ETW, 4 1/2" x 4 1/2"	
1.5	Pr. Hinges	Hager	HT BB1168, 4 1/2" x 4 1/2"	
1	EC Mortise Lockset	Corbin-Russwin	ML20903-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
1	Wall Bumper	Hager	234D	

Door Hardware Set No. 12**Interior Wood Doors & Metal Frame-Secured**

1.0	Pr. Hinges (Electrified)	Hager	HT BB1168-ETW, 4 ½" x 4 ½"	
2.0	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
2	Exit Device w/ELR	Corbin-Russwin	ED5200-MELR-08-ASM	630
2	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
2	Wall Bumper	Hager	234D	

Door Hardware Set No. 13**Interior Wood Pair Doors in Metal Frame**

3	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	Lockset – Storage	Corbin-Russwin	ML2057-ASM -M25	630
2	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder			
2	Kickplates	Hager, 12"x1"LDW		
1	Automatic Flushbolt	Hager		

Door Hardware Set No. 14**Interior Wood Pair Doors in Metal Frame**

3	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	Lockset – Passage	Corbin-Russwin	ML2010-ASM	630
2	Closers w/Hold-open	Corbin-Russwin	DC6210xA1 w/Hold-open	689
1	Cylinder			
2	Kickplates	Hager, 12"x1"LDW		
1	Automatic Flushbolt	Hager		

Door Hardware Set No. 15**Interior Wood Pair Doors in Metal Frame**

3	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	Lockset – Storage	Corbin-Russwin	ML2057-ASM-M25	630
2	Closers w/Hold-open	Corbin-Russwin	DC6210xA1 w/Hold-open	689
1	Cylinder			
2	Kickplates	Hager, 12"x1"LDW		
1	Automatic Flushbolt	Hager		

Door Hardware Set No. 16**Interior Wood Doors & Metal Frame**

1.5	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	Lockset - Office	Corbin-Russwin	ML2051-ASM	630
1	Cylinder			
2	Kickplates	Hager, 12"x1"LDW		

Door Hardware Set No. 17**Interior Wood Doors & Metal Frame-Secured**

0.5	Pr. Hinges (Electrified)	Hager	HT BB1168-ETW, 4 ½" x 4 ½"	
1.5	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	EC Mortise Lockset	Corbin-Russwin	ML20903-ASM	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
1	Wall Bumper	Hager	234D	

Door Hardware Set No. 18**Interior Wood Doors & Metal Frame-Secured**

0.5	Pr. Hinges (Electrified)	Hager	HT BB1168-ETW, 4 ½" x 4 ½"	
1.5	Pr. Hinges	Hager	HT BB1168, 4 ½" x 4 ½"	
1	EC Mortise Lockset	Corbin-Russwin	ML20903-ASM-M25	630
1	Closers	Corbin-Russwin	DC6210xA1	689
1	Cylinder	Corbin Russwin		
1	Card Reader (Provided and installed by Owner)	Provide all low-voltage wiring to location.		
1	Wall Bumper	Hager	234D	

END OF SECTION 087100

SECTION 088000 - GLAZING

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. Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Tinted glass.
 - 2. Coated glass.
 - 3. Insulating glass.
- C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For tinted glass, coated glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Project Acceptance.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GGI; General Glass International.
 - b. PPG Industries, Inc.
 - c. Vetrotech Saint-Gobain.
 - d. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 1. Obtain tinted glass from single source from single manufacturer.
 2. Obtain reflective-coated glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 1. Design Wind Pressures: As indicated on Drawings.
 2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 2. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 3. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 4. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.
- E. Ceramic-coated, low-E, insulating spandrel glass.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary sealants.
 - 2. Spacer: Aluminum with mill or clear anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
 4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Project Acceptance. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type : Clear fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

A. Glass Type : Low-E-coated, tinted insulating glass.

1. Basis-of-Design Product: PPG, Solarban 70XL Solexia + Clear
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted fully tempered float glass.
5. Tint Color: Solexia (Light Green).
6. Interspace Content: Manufacturer's Standard.
7. Indoor Lite: Clear fully tempered float glass.
8. Low-E Coating: Sputtered on second surface.
9. Winter Nighttime U-Factor: 0.28 maximum.
10. Summer Daytime U-Factor: 0.26 maximum.
11. Visible Light Transmittance: 58% percent minimum.
12. Solar Heat Gain Coefficient: 0.27 maximum.
13. Light to Solar Gain (LSG); 2.15
14. Safety glazing required.

B. Glass Type: Ceramic-coated, low-E, insulating spandrel glass.

1. Basis-of-Design Product: ICD OPACI-Coat 300.
2. Coating Color: As selected by Architect from manufacturer's full range to match Insulated Glass
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 6 mm.
5. Outdoor Lite: Ultraclear fully tempered float glass.
6. Interspace Content: Manufacturer's Standard.
7. Indoor Lite: Fully tempered float glass.
8. Low-E Coating: Sputtered on second surface.
9. Opaque Coating Location: Fourth surface.
10. Winter Nighttime U-Factor: 0.28 maximum.
11. Summer Daytime U-Factor: 0.26 maximum.

END OF SECTION 088000

SECTION 088300 - MIRRORS

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 the following types of silvered flat glass mirrors:
 - 1. Tempered glass mirrors qualifying as safety glazing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- C. Samples: For each type of the following products:
 - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
 - 2. Mirror Clips: Full size.
 - 3. Mirror Trim: 12 inches long.

1.4 CLOSEOUT SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- C. Glazing Publications: Comply with the following published recommendations:
 - 1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
- D. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

- A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
 - 1. Nominal Thickness: 5.0 mm

2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror manufacturer and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
 - 1. Adhesive shall have a VOC content of not more than 70 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

- A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.05 inch.
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.062 inch.
3. Finish: Clear bright anodized.

B. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.

B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Rounded polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Wall-Mounted Mirrors: Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 - 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Project Acceptance. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 089119 - FIXED LOUVERS

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. Fixed extruded-aluminum louvers.
 - 2. Blank-off panels for louvers

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

- A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
1. 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. Warranty Period: 20 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal Drainable-Blade Louver:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Airline Louvers; a division of Mestek, Inc.
 - b. Airolite Company, LLC (The).
 - c. Arrow United Industries.
 - d. Construction Specialties, Inc.
 - e. Greenheck Fan Corporation.
 - f. Louvers & Dampers, Inc.; a division of Mestek, Inc.
 - g. Ruskin Company.
 2. Louver Depth: 4 inches.
 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
 4. Mullion Type: Exposed.
 5. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
 - b. Point of Beginning Water Penetration: Not less than 1000 fpm.
 - c. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area exhaust velocity.
 - d. Air Performance: Not more than 0.15-inch wg static pressure drop at 1000-fpm free-area intake velocity.
 - e. See Mechanical Drawings for Louver Schedule, Final Sizes, and Free Area Requirements.
 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
 - 1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.4 BLANK-OFF PANELS

- A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 - 1. Thickness: 1 inch.
 - 2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
 - 3. Insulating Core: extruded-polystyrene foam.
 - 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
 - 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 - 6. Panel Finish: Same type of finish applied to louvers, but black color.
 - 7. Attach blank-off panels with clips or sheet metal screws.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - 2. Exterior Corners: Prefabricated corner units with mitered blades with concealed close-fitting splices and with fully recessed mullions at corners.
- G. Provide subsills made of same material as louvers for recessed louvers.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for 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. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092216 - 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 gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DESCRIPTION

- 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. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **25** percent.

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, hot-dip galvanized, unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
 - 1. Steel Studs and Runners:

- a. Minimum Base-Metal Thickness: 0.018 inch U.N.O.
 - b. Depth: As indicated on Drawings
- 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: As indicated on Drawings or 0.015 inch.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the 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.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: As indicated on Drawings or 0.018 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.018 inch.
 - 2. Depth: 7/8 inch.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
 - 1. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: 2-1/2 inches.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.018 inch.
 - b. Depth: 2-1/2 inches.
 - 3. Dimpled Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.015 inch.
 - b. Depth: 2-1/2 inches.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.018 inch.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

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, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. 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. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 - 1. Space studs as follows:
 - a. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - b. Multilayer Application: 16 inches o.c. unless otherwise indicated.
 - c. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- C. Install tracks (runners) 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 penetrating 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 runner 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 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.

D. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

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.
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. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

- E. 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.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - 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.
 - 2. Exterior gypsum board for ceilings and soffits.
 - 3. Tile backing panels.
 - 4. Acoustically enhanced gypsum board.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Data: For adhesives and sealants, indicating VOC content.
 - 3. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
 - 4. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

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 recommendations, 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, those that are moisture damaged, and those that are 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.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 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.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.
- C. Regional Materials: Manufacture products within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- D. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.

2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

B. Acoustically Enhanced Gypsum Board: ASTM C1766. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.

1. Core: 5/8 inch , regular type.
2. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; GlasRoc Sheathing.
 - b. Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond, e(2)XP.
 - d. USG Corporation; Securock Glass Mat Sheathing.

2. Core: 5/8 inch.

2.6 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Thickness: 5/8 inch.
2. Mold Resistance: ASTM D 3273, score of 10.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
 - a. Cornerbead.

- b. LC-Bead: J-shaped; exposed long flange receives joint compound.
- c. L-Bead: L-shaped; exposed long flange receives joint compound.
- d. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
- 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
- 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

- 1. Interior Gypsum Board: Paper.
- 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- 3. Tile Backing Panels: As recommended by panel manufacturer.

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, rounded or beveled panel edges, 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.

D. Joint Compound for Tile Backing Panels:

- 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

- 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- 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.
 - 2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 40 percent.

- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AC-20 FTR.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- E. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- 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 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. 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-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-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. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. 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. Type X: Where required for fire-resistance-rated assembly.
 - 3. Cementitious backer board: Behind all ceramic tile locations
- 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.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing

- members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. 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.
 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 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 at locations indicated on Drawings 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. LC-Bead: Use at exposed panel edges.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.7 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, rounded or beveled edges, 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 2: Panels that are substrate for tile.

3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 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 092900

SECTION 093013 - CERAMIC TILING

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. Ceramic mosaic tile.
 - 2. Porcelain tile.
 - 3. Stone thresholds.
 - 4. Waterproof membrane.
 - 5. Crack isolation membrane.
 - 6. Metal edge strips.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Stone thresholds in 6-inch lengths.
 - 5. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Stone thresholds.
 - 2. Waterproof membrane.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

- A. Ceramic Tile (CT-1) Ceramic Floor Tile
 - 1. Basis of Design: Caesar Ceramics, Foundry 26, Rail: or provide a comparable product by one of the following:
 - a. American Olean; a division of Dal-Tile Corporation
 - b. Daltile
 - c. Tile Bar
 - d. Trinity Tile
 - 2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
 - 3. Module Size: 12 by 24 inches.
 - 4. Thickness: 8mm.
 - 5. Face: Plain with cushion edges.
 - 6. Dynamic Coefficient of Friction: Not less than 0.42.
 - 7. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
 - 8. Grout Color: As selected by Architect from manufacturer's full range.
 - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. External Corners: Metal trim by Schluter (anodized aluminum)..

- b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Ceramic Tile (CT-2) Ceramic wall tile

- 1. Basis of Design: Ceasar Ceramics, Foundry 26, Zinc, or provide a comparable product by one of the following:
 - a. American Olean; a division of Dal-Tile Corporation
 - b. Daltile
 - c. Tile Bar
 - d. Trinity Tile
- 2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
- 3. Module Size: 24 by 48 inches.
- 4. Thickness: 8mm.
- 5. Face: Plain with cushion edges.
- 6. Dynamic Coefficient of Friction: Not less than 0.42.
- 7. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
- 8. Grout Color: As selected by Architect from manufacturer's full range.
- 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. External Corners: Metal trim by Schluter (anodized aluminum)..
 - b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

C. Ceramic Tile (CT-3) Ceramic floor tile

- 1. Basis of Design: Ceasar Ceramics, Foundry 26, Rail, or provide a comparable product by one of the following:
 - a. American Olean; a division of Dal-Tile Corporation
 - b. Daltile
 - c. Tile Bar
 - d. Trinity Tile
- 2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
- 3. Module Size: 24 by 24 inches.
- 4. Thickness: 8mm.
- 5. Face: Plain with cushion edges.
- 6. Dynamic Coefficient of Friction: Not less than 0.42.
- 7. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
- 8. Grout Color: As selected by Architect from manufacturer's full range.

D. Ceramic Tile Type (CT-4) Ceramic wall tile

1. Basis of Design: Caesar Ceramics, Foundry 26, Zinc, or provide a comparable product by one of the following:
 - a. American Olean; a division of Dal-Tile Corporation
 - b. Daltile
 - c. Tile Bar
 - d. Trinity Tile
2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 12 by 24 inches.
4. Thickness: 8mm.
5. Face: Plain with cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
8. Grout Color: As selected by Architect from manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. External Corners: Metal trim by Schluter (anodized aluminum)..
 - b. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.
 1. Description:
 - a. Uniform, black stone.
 - b. Match Architect's sample.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 1. Thickness: 5/8 inch.

2.6 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, SBS-modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products Corporation; a QEP company.
 - b. Custom Building Products.
 - c. H.B. Fuller Construction Products Inc. / TEC.
 - d. National Applied Construction Products, Inc.
- C. Waterproof Membrane, Fabric-Reinforced, Fluid-Applied: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boiardi Products Corporation; a QEP company.
 - b. Bostik, Inc.
 - c. Custom Building Products.
 - d. H.B. Fuller Construction Products Inc. / TEC.
 - e. Laticrete International, Inc.
 - f. MAPEI Corporation.
 - g. Summitville Tiles, Inc.
- D. Waterproofing and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both waterproofing and tile-setting adhesive in a two-step process.
 - 1. Verify adhesives have a VOC content of 65 g/L or less.

2.7 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - 1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils thick.
 - 2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.
 - 3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
 - 1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.
- C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

- A. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic, designed specifically for flooring and corner applications; exposed-edge material.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Schluter Systems L.P.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: Standard sheet size spacing
 - 2. Porcelain Tile: 1/4 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
 - 2. Do not extend cleavage membrane waterproofing under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane or waterproofing with elastomeric sealant.

3.4 TILE BACKING PANEL INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor including Shower Pan:
 - 1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1B; cement mortar bed (thickset) on waterproof membrane.
 - a. Ceramic Tile Type: CT-1.
 - b. Bond Coat for Cured-Bed Method: Latex- portland cement mortar.
 - c. Grout: Water-Cleanable Epoxy Grout.
 - d. Location: As noted.
 - e. Fabric-Reinforced, Modified-Bituminous Sheet to 4" above finished floor.
 - f. Cleavage Membrane.
 - 2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.
 - a. Ceramic Tile Type: CT-3.
 - b. Thinset Mortar: Latex- portland cement mortar.
 - c. Grout: Water-Cleanable Epoxy Grout.
 - d. Location: As noted.
 - e. Fabric-Reinforced, Modified-Bituminous Sheet to 4" above finished floor.
- B. Interior Wall Installations, Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units.

- a. Ceramic Tile Type: CT-2, CT-4.
- b. Thinset Mortar: Latex- portland cement mortar.
- c. Grout: Water-Cleanable Epoxy Grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Laboratory Test Reports: For ceiling products, indicating compliance with requirements for low-emitting materials.
- C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- D. Samples for Initial Selection: For components with factory-applied finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

1.4 CLOSEOUT SUBMITTALS

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

1.5 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 Units: 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.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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 weathertight, 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 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: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 450 or less.
- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

2.3 ACOUSTICAL PANELS (APC)

- A. Basis of Design Product: Subject to compliance with requirements, provide Armstrong World Industries, "Cirrus Tegular High NRC #556", or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. Tectum Inc.

5. USG Interiors, Inc.; Subsidiary of USG Corporation

- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
 - 1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
 - 2. Pattern: E (Lightly textured).
- C. Color: White.
- D. Light Reflectance (LR): Not less than 0.85.
- E. Ceiling Attenuation Class (CAC): Not less than 35.
- F. Noise Reduction Coefficient (NRC): Not less than 0.75.
- G. Edge/Joint Detail: Beveled, Tegular.
- H. Thickness: 3/4 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL WOOD PANEL CEILING TILE (WP)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armstrong World Industries, Inc. (Basis of Design; LYRA PB)
 - 2. CertainTeed; SAINT-GOBAIN.
 - 3. USG Corporation.
- B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 70 percent.
- D. Classification: Provide tiles as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Type XII, Form 2.
 - 2. Pattern: E (lightly textured).
- E. Color: As selected from manufacturer's full range.
- F. Light Reflectance (LR): Not less than 0.88.
- G. Noise Reduction Coefficient (NRC): Not less than 0.95.
- H. Articulation Class (AC): Not less than 190.

- I. Edge/Joint Detail: 9/16" Square Tegular.
- J. Thickness: 1-inch.
- K. Modular Size: 48 x 48.
- L. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 METAL SUSPENSION SYSTEM (Use with APC)

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- B. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled 15/16 inch steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
 - 1. Structural Classification: Heavy-duty system.
 - 2. Face Finish: Painted white.
- 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.
 - 1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- 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 0.135-inch-diameter wire.
- E. Hanger Rods Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

2.6 METAL SUSPENSION SYSTEM (Use with WP)

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.
- B. **Recycled Content:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. Provide 9/16", Silhouette ¼" Reveal profile.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. Gordon, Inc.
 - 5. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.8 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following
 - 1. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.

PART 3 - EXECUTION

3.1 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.

3.2 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 unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- 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. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 5. 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.
 - 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.
- 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 edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- F. 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 precise fit.
 - 1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 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.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Aluminum pans for acoustical metal pan ceiling.
 2. Metal suspension system for acoustical, snap-in metal pan ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include procedure for cutting metal pans.
1. Aluminum pans for acoustical metal pan ceiling.
 2. Steel pans for acoustical metal pan ceiling.
 3. Stainless steel pans for acoustical metal pan ceiling.
 4. Metal suspension system for acoustical, standard-grid metal pan ceilings.
 5. Metal suspension system for acoustical, snap-in metal pan ceilings.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
1. Metal Pans: Set of 6-inch-square Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
 3. Sound Absorber: Sample of each type matching size of Sample metal pan.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which suspension systems will be attached.
 3. Size and location of access modules for acoustical panels.
 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 5. Perimeter moldings.

1.4 CLOSEOUT SUBMITTALS

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

1.5 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 Metal Pans with Sound Absorber: Full-size units equal to 5 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to 5 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as indicated on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Project Acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E1264 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 E795.
- C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
 - 1. Aluminum Sheet: Rolled aluminum sheet, complying with ASTM B209; alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- D. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E84.
 - 1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.
- E. Adhesive: Manufacturer's standard nonflammable adhesive for sound-absorbent fabric.

2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING

- A. Aluminum Pans for Acoustical Metal Pan Ceiling: MP.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Ceiling & Wall Solutions; Metalworks RH200 Perforations (Basis of Design)
 - b. CertainTeed; SAINT-GOBAIN.
 - c. USG Corporation.
- B. Classification: Units complying with ASTM E1264 for Type XX, other types described as perforated aluminum facing (pan) units with sound-absorbent fabric backing.
 - 1. Pattern: M22; Oblong-Staggered; 22% open.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
 - 1. Clip-in Pans: Designed to clip in and be securely retained in exposed suspension grid by formed edges or accessory clips provided by manufacturer.
- D. Pan Thickness: Not less than 0.040 inch.
- E. Pan Edge Detail: Square.

- F. Pan Joint Detail: Butt.
- G. Pan Size: 24 by 96 inches.
- H. Pan Face Finish: Clear anodized.
- I. NRC: Not less than 0.60.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard J-Bar metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635/C635M requirements.
- B. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.
- F. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Hold-Down Clips: Manufacturer's standard hold-down clips spaced to secure acoustical metal pans in place at each pan.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL SNAP-IN METAL PAN CEILINGS

- A. Direct-Hung, Snap-J Bar System: Designed to support metal pans that snap into main runners, consisting of main runners supported by hangers attached directly to building structure, and complying with the following requirements:
 - 1. Hangers: Angles or channels, as standard with ceiling system manufacturer, formed from same metal as main runners.

2. Main Runners: Rolled aluminum sheet; alloy and temper recommended by aluminum producer and finisher for type of use indicated and manufacturer's standard finish, complying with ASTM B209.

B. Access Panels: For access at locations indicated, provide acoustical snap-in metal pan ceiling units, accessible by key or tool.

1. Access Key or Tool: Provide manufacturer's standard key or tool for opening access panels; two.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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.

C. High-Humidity Finish: Comply with ASTM C635/C635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan 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 metal pan ceilings.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C636/C636M and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- D. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet. Cut and treat edges to comply with manufacturer's written instructions.
- E. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.
 - 1. For clip-in pans, position pans according to manufacturer's written instructions.
 - 2. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 - 3. Fit adjoining units to form flush, tight joints.
 - 4. Install directionally patterned or textured metal pans in directions indicated.
 - 5. Install sound-absorbent fabric layers in, and bond to, perforated metal pans.
 - 6. Install sound-absorbent pads in perforated metal pans.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, 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, including dented and bent units.

END OF SECTION 095133

SECTION 096513 - RESILIENT BASE AND 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. Resilient base.
 - 2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.4 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Product Standard: ASTM F 1861, NSF 332, Group I (solid, homogeneous).
- B. Thickness: 0.125 inch.
- C. Height: 5-1/4" inches.
- D. Profile: Impulse #15 by Roppe, 123 Charcoal (Basis of Design); or provide comparable product by Johnsonite or Armstrong.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: As selected by Architect from full range of industry colors.

2.2 RUBBER MOLDING ACCESSORY

- A. Description: Rubber carpet edge for glue-down applications, nosing for resilient flooring.
- B. Locations: Provide rubber molding accessories at all changes in flooring material.
- C. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Project Acceptance.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

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. Luxury vinyl floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Samples for Initial Selection: For each type of floor tile indicated.
- E. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F, in spaces to receive floor tile during the following periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. After installation and until Project Acceptance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LUXURY VINYL FLOOR TILE (LV-1)

- A. Basis of Design: Shaw Contract, Coded 4143V, Share 43585, or provide a comparable product by one of the following:
 1. Bentley Mills
 2. Mannington Group
 3. Patcraft

- B. Tile Standard: ASTM F1700.
 - 1. Class: Class III, Printed Film Vinyl Tile.
 - 2. Type: B, Embossed Surface.
- C. Thickness: 0.197 inches.
- D. Size: 6 by 48 inches.
- E. Colors and Patterns: As indicated by Architect from full range of industry colors and patterns.
- F. Installation: Monolithic running East-West.
- G. Colors and Patterns: As indicated by Architect from full range of industry colors and patterns.

2.3 LUXURY VINYL FLOOR TILE (LV-2)

- A. Basis of Design: Shaw Contract, Type 4142V, Engage 42595, or provide a comparable product by one of the following:
 - 1. Bentley Mills
 - 2. Mannington Group
 - 3. Patcraft
- B. Tile Standard: ASTM F1700.
 - 1. Class: Class III, Printed Film Vinyl Tile.
 - 2. Type: B, Embossed Surface.
- C. Thickness: 0.197 inches.
- D. Size: 24 by 24 inches.
- E. Colors and Patterns: As indicated by Architect from full range of industry colors and patterns.
- F. Installation: Brick running North-South.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. Adhesives shall comply with the following for VOC content: Vinyl Composition Tile Adhesives: 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 1. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles square with room axis in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096519

SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

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. Thin-set, epoxy-resin terrazzo flooring.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
 - 1. Divider strips.
 - 2. Control-joint strips.
 - 3. Accessory strips.
 - 4. Terrazzo patterns.
- C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- D. Samples for Initial Selection: NTMA's "Terrazzo Color Palette" showing the full range of colors and patterns available for each terrazzo type.
- E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:

1. Terrazzo: 6-inch- square Samples.
2. Accessories: 6-inch- long Samples of each exposed strip item required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each type of terrazzo material or product.
- C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.
- D. Preinstallation moisture-testing reports.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Engage an installer who is a contractor member of NTMA.
 2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 1. Build mockups for terrazzo including accessories.
 - a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring condition for each color and pattern in locations directed by Architect.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.3 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo: Comply with manufacturer's written instructions for matrix and aggregate proportions and mixing.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crossfield Products Corp.
 - b. Doyle Dickerson Terrazzo, Inc.
 - c. Hi-Tek Polymers, Inc.
 - d. Key Resin Company.
 - e. Master Terrazzo Technologies LLC.
 - f. Sherwin-Williams Company, General Polymers.
 - g. Terrazzo & Marble Supply Companies.
- B. Mix Color and Pattern: (Basis of Design: The National Terrazzo & Mosaic Association, EPI-50) As selected by Architect from NTMA full range. Allow for multiple colors. Broadcast aggregates for sprinkled pattern.

C. Materials:

1. Moisture-Vapor-Emission-Control Membrane: Two-component, high-solids, high-density, low-odor, epoxy-based membrane-forming product produced by epoxy terrazzo manufacturer that reduces moisture emission from concrete substrate to not more than 3 lb of water/1000 sq. ft. in 24 hours.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated with uneven aggregate distribution.
 - a. Physical Properties without Aggregates:
 - 1) Hardness: 60 to 85 per ASTM D2240, Shore D.
 - 2) Minimum Tensile Strength: 3000 psi per ASTM D638 for a 2-inch specimen made using a "C" die per ASTM D412.
 - 3) Minimum Compressive Strength: 10,000 psi per ASTM D695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D1308.
 - a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 5 percent acetic acid.
 - h) 10 percent sodium hydroxide.
 - i) 10 percent hydrochloric acid.
 - j) 30 percent sulfuric acid.
 - b. Physical Properties with Aggregates: For terrazzo blended according to manufacturer's recommendations with one part epoxy resin with three parts marble aggregate consisting of 60 percent No. 1 chips and 40 percent No. 0 chips that is ground and grouted to a 1/4-inch nominal thickness, and cured/coor for 7 days at 75 deg F plus or minus 2 deg F and at 50 percent plus or minus 2 percent relative humidity.
 - 1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch according to ASTM D635.
 - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F according to ASTM C531.
4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.
5. Finishing Grout: Resin based.

2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle in depth required for topping thickness indicated.
 - 1. Material: White-zinc alloy or Aluminum.
 - 2. Top Width: 1/4 inch.
- B. Heavy-Top Divider Strips: L-type angle in depth required for topping thickness indicated.
 - 1. Bottom-Section Material: Matching top-section material.
 - 2. Top-Section Material: White-zinc alloy or Aluminum <Insert requirements>.
 - 3. Top-Section Width: 1/4 inch.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices:
 - 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; and is recommended by sealer manufacturer.
 - 1. Surface Friction: Not less than 0.6 according to ASTM D2047.
 - 2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
 - 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written instructions.
 - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
- D. Preinstallation Moisture Testing:
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Moisture-Vapor-Emission Test: Maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours when tested according to ASTM F1869 using anhydrous calcium chloride.
 - b. Relative Humidity Test: Maximum 75 percent relative humidity measurement when tested according to ASTM F2170 using in-situ probes.
 - 2. Proceed with terrazzo installation only after concrete substrates pass moisture testing or after installation of moisture-vapor-emission-control membrane on substrate areas that fail testing.
- E. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Strip Materials:
 - 1. Divider and Control-Joint Strips:
 - a. Locate divider strips in locations indicated.
 - b. Install control-joint strips back to back and directly above concrete-slab control joints and in locations indicated.
 - c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.

- d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
2. Accessory Strips: Install as required to provide a complete installation.
- C. Apply primer to terrazzo substrates according to manufacturer's written instructions.
- D. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions.
 1. Installed Thickness: 3/8 inch nominal.
 2. Terrazzo Finishing: Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
 - a. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond abrasives. Follow initial grind with 60/80-grit stones or with comparable diamond abrasives.
 - b. Grouting: Before grouting, clean terrazzo with water, rinse, and allow to dry. Apply and cure epoxy grout.
 - c. Fine Grinding/Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with 120-grit stones or with comparable diamond abrasives until grout is removed from surface.
 3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.5 CLEANING AND PROTECTION

- A. Cleaning:
 1. Remove grinding dust from installation and adjacent areas.
 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
 1. Seal surfaces according to NTMA's written recommendations.
 2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Project Acceptance.

END OF SECTION 096623

SECTION 096813 - TILE CARPETING

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 modular carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Carpet tile type, color, and dye lot.
 - 2. Type, color, and location of edge, transition, and other accessory strips.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Delamination.
 - 3. Warranty Period: 10 years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 CARPET TILE (CR-1)

- A. Basis of Design: Shaw Contract, Establish Tile 5T268, Clear 67486, or provide a comparable product by one of the following:
 - 1. Bentley Mills
 - 2. Mannington Group
 - 3. Patcraft

- B. Color: As indicated by manufacturer's designations.
- C. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- D. Size: 12 by 48 inches.
- E. Installation: Monolithic running North-South.

2.2 CARPET TILE (CR-2)

- A. Basis of Design: Shaw Contract, Convene Tile 5T269, Clear Foundation 67583, or provide a comparable product by one of the following:
 - 1. Bentley Mills
 - 2. Mannington Group
 - 3. Patcraft
- B. Color: As indicated by manufacturer's designations.
- C. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- D. Size: 9 by 36 inches.
- E. Installation: Ashlar running North-South.

2.3 CARPET TILE (CR-3)

- A. Basis of Design: Shaw Contract, Establish Tile 5T268, Foundation 67580, or provide a comparable product by one of the following:
 - 1. Bentley Mills
 - 2. Mannington Group
 - 3. Patcraft
- B. Color: As indicated by manufacturer's designations.
- C. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- D. Size: 12 by 48 inches.
- E. Installation: Monolithic running East-West.
- F. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- G. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
 - 1. VOC Limits: Provide adhesives with VOC content not more than 50- g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits. Verify that concrete slabs comply with the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 4. substances that may interfere with adhesive bond or show through surface.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.

- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel.
 - 2. Galvanized metal.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish all extra unused paint, plus no less than 1 unopened gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Duron, Inc.
 - 3. ICI Paints.
 - 4. Porter Paints.
 - 5. PPG Architectural Finishes, Inc.
 - 6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. **VOC Content:** For field applications, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.
 - 5. Rust-Preventive Coatings: 100 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
- C. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

- A. Exterior, Latex Wood Primer: White, waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on exterior wood subject to extractive bleeding.
- B. Quick-Drying, Alkyd Metal Primer: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, exterior steel surfaces.

2.4 FINISH COATINGS

- A. Exterior Latex Paint, Gloss: Water-based, pigmented, acrylic-copolymer-emulsion coating formulated for alkali, mold, microbial, scrub, blocking (sticking of two painted surfaces), and water resistance and for use on exterior, primed, wood and metal trim, sashes, frames, and doors.
 - 1. Gloss Level: Manufacturer's standard gloss finish.
- B. Quick-Drying Alkyd Enamel, Gloss: Solvent-based, alkyd or modified-alkyd enamel formulated for quick-drying capabilities and for use on exterior, primed, metal and dimensionally stable wood surfaces.
 - 1. Gloss Level: Manufacturer's standard gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. Quick-Drying Enamel System:

- a. Prime Coat: Quick-drying, alkyd metal primer.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Quick-drying alkyd enamel, gloss.

B. Exterior Gypsum Board Substrates:

1. Latex System:

- a. Prime Coat: Exterior, latex wood primer, reduced in accordance with manufacturer's written instructions for substrate and topcoat.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Exterior latex paint, gloss.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

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. Primers.
 - 2. Water-based finish coatings.
 - 3. Solvent-based finish coatings.
 - 4. Floor sealers and paints.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Samples: For each type of topcoat product.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 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. Paint Products: 10 percent, but not less than 1 full, unopened gallon of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Paints.
 - 3. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.

C. Colors: As selected by Architect from manufacturer's full range.

1. Ten percent of surface area will be painted with deep tones.
2. Allow for multiple (up to two colors in all rooms).

2.3 PRIMERS

A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

B. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

C. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.

1. Gloss Level: Manufacturer's standard semigloss finish.

2.5 FLOOR SEALERS AND PAINTS

- A. Latex Floor Paint, Low Gloss: Water-based, pigmented coating formulated to hide stains, for alkali and incidental water resistance, and for use on concrete and primed-wood surfaces subject to low to medium foot traffic.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.

- d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
 - 1. Latex Floor Enamel System (ECP):
 - a. Prime Coat: Matching topcoat
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Latex floor paint, low gloss.
- B. Steel Substrates:
 - 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.
- C. Galvanized-Metal Substrates:
 - 1. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Water-based galvanized primer.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss.

END OF SECTION 099123

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

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. Cast dimensional characters.
 - 2. Fabricated channel dimensional characters.
 - 3. Illuminated, fabricated channel dimensional characters.

1.3 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
 - 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

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

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL CHARACTERS

- A. Cast Characters Insert drawing designation: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ACE Sign Systems, Inc.
 - b. ASI Sign Systems, Inc.
 - c. Gemini Incorporated.
 - d. Metal Arts.
 - 2. Character Material: Cast aluminum.
 - 3. Character Height: As indicated on Drawings.
 - 4. Thickness: Manufacturer's standard for size of character.

5. Finishes:
 - a. Integral Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
 6. Mounting: Concealed studs.
 7. Typeface: As indicated.
- B. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ACE Sign Systems, Inc.
 - b. ASI Sign Systems, Inc.
 - c. Gemini Incorporated.
 - d. Metal Arts.
 2. Illuminated Characters: Backlighted character construction with LED lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: 120 V, 60 Hz, 1 phase, 15 A.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters.
 3. Character Material: Sheet or plate aluminum.
 4. Material Thickness: Manufacturer's standard for size and design of character.
 5. Character Height: As indicated on Drawings.
 6. Character Depth: As indicated on Drawings.
 7. Finishes:
 - a. Integral Aluminum Finish: Clear anodized or Anodized color as selected by Architect from full range of industry colors and color densities.
 8. Mounting: Manufacturer's standard for size and design of character.
 - a. Hold characters at 2-inch distance from wall surface.
 9. Typeface: As indicated.

2.3 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
 - 2. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

2.8 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 - 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.

5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423 –PANEL SIGNAGE

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. This Section includes the following:

- 1. Panel signs.

1.3 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."
- B. ACCESSIBILITY STANDARD: ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES. ICC A117.1-2009.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Aluminum.
 - 2. Acrylic sheet.
 - 3. Polycarbonate sheet.
 - 4. Fiberglass sheet.
 - 5. Die-cut vinyl characters and graphic symbols. Include representative samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
 - 1. Panel Signs: Not less than 12 inches square including border.

- E. Sign Schedule: Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- B. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when[existing and forecasted] weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fiberglass Sheet: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with a minimum tensile strength of 15,000 psi when tested according to ASTM D 638 and with a minimum flexural strength of 30,000 psi when tested according to ASTM D 790.
- B. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- C. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
 - 4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.
 - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- D. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

2.2 PANEL SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ACE Sign Systems, Inc.
 2. Advance Corporation; Braille-Tac Division.
 3. APCO Graphics, Inc.
 4. ASI-Modulex, Inc.
 5. Best Sign Systems Inc.
 6. Gemini Incorporated.
 7. Mohawk Sign Systems.
 8. Avali's Wayfinding Solutions, Inc,
- B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. Melamine Plastic Laminate, All signs 0.25 inch thick.
 2. Edge Condition: Square cut.
 3. Corner Condition: Square.
 4. Mounting: Unframed.
 - a. Wall mounted with two-face tape.
 - b. Manufacturer's standard anchors for substrates encountered.
 5. Color: As selected by Architect from manufacturer's full range.
 6. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.
- C. Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. Melamine Plastic Laminate, 0.250-inch thick.
 2. Edge Condition: Square cut.
 3. Corner Condition: Square.
 4. Mounting: Unframed.
 - a. Wall mounted.
 - b. Manufacturer's standard noncorroding anchors for substrates encountered.
 5. Color: As selected by Architect from manufacturer's full range.
- D. Panel Sign Schedule (Mohawk Sign Systems, Inc. –Basis for Design):
1. PS #1: Room Identification Sign with Braille.
 - a. Sign Size: 6"x6"x 1/4".
 - b. Message Panel Material: Interior Panel Sign, Series 300.
 - c. Text/Message: Room #.
 - d. Location: As directed in the field by Architect.
 - e. Quantity: Provide one per interior non-occupied room such as Mechanical, Data, Electrical Rooms.
 2. PS #2: Room Identification Sign with Braille and Two Changeable Message Insert.
 - a. Sign Size: 6"x6"x 1/4".

- b. Message Panel Material: Interior Panel Sign, Series 300 w/two changeable message inserts.
 - c. Text/Message: Room #.
 - d. Location: As directed in the field by Architect.
 - e. Quantity: Provide one per occupied room except two if there are two doors.
- 3. PS #3: Room Identification Sign with pictograms and Braille.
 - a. Sign Size: 6"x8"x 1/4".
 - b. Message Panel Material: Interior Panel Sign, Series 300 w/male or female pictogram and accessibility symbol.
 - c. Text/Message: Male or Female.
 - d. Location: As directed in the field by Architect.
 - e. Quantity: one per toilet room, gender as indicated by room name.
- 4. PS #5: Room Identification Sign with Braille- Exterior:
 - a. Sign Size: 6"x6"x 1/4".
 - b. Message Panel Material: Exterior Panel Sign, Series 300.
 - c. Text/Message: Room #.
 - d. Location: As directed in the field by Architect.
 - e. Quantity: Provide one at each exterior mechanical or electrical room exterior door.

2.3 ACCESSORIES

- A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.4 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ACRYLIC SHEET FINISHES

- A. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for three years for application intended.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, are sized and located to accommodate signs.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
 - 2. Hook-and-Loop Tapes: Mount signs to smooth, nonporous surfaces.
 - 3. Magnetic Tape: Mount signs to smooth, nonporous surfaces.
 - 4. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces.
 - 5. Shim Plate Mounting: Provide 1/8-inch-thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach panel signs to plate using method specified above.
 - 6. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
 - 7. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

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. Solid-polymer toilet compartments configured as toilet enclosures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- B. Stainless-Steel Castings: ASTM A 743/A 743M.

2.2 SOLID-POLYMER UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Accurate Partitions Corporation; ASI Group (Tough Texture TT).
 - 2. Global Partition Systems; ASI Group (Tough Texture TT).
 - 3. Scranton Products (Basis of Design, Hiny Hiders Santana-Comtec Grip EX Texture)
- B. Toilet-Enclosure Style: Overhead braced.
- C. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
 - 2. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range. Provide surface texture pattern similar to Hiny Hiders Santana-Comtec "Grip EX" Collection.
- D. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.
- E. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Stainless steel.
 - 2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
 - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 36-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two

fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102239 - FOLDING PANEL PARTITIONS

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. Electrically operated, acoustical panel partitions.

1.3 DEFINITIONS

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. STC: Sound Transmission Class.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable panel partitions.
 - 1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
 - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
 - 1. Textile Facing Material: Full width by not less than 36-inch-long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
 - 2. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
 - 3. Panel Edge Material: Not less than 3 inches long.
 - 4. Hardware: One of each exposed door-operating device.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.
 - c. Electric operator and controls.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.

2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
 3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
- C. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kwik-Wall . (Model 3050, Basis of Design)
 - b. Modernfold, Inc.
 - c. Moderco Inc.
- B. Panel Operation: Electrically operated, continuously hinged panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Standard widths.
- E. STC: Not less than 52.
- F. Panel Weight: 12 lb/sq. ft. maximum.
- G. Panel Thickness: Not less than 4 inches.
- H. Panel Materials:

1. Steel Frame: Steel sheet, manufacturer's standard nominal minimum thickness for uncoated steel.
 2. Steel Face/Liner Sheets: Tension-leveled steel sheet, manufacturer's standard minimum nominal thickness for uncoated steel.
- I. Panel Closure: Manufacturer's standard unless otherwise indicated.
1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
 2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.
- J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
1. Hinges: Concealed (invisible).

2.3 SEALS

- A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
1. Seals made from materials and in profiles that minimize sound leakage.
 2. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track or PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
1. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1 inch between retracted seal and floor finish.

2.4 PANEL FINISH FACINGS

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
 3. Match facing pattern 72 inches above finished floor.

- B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
 - 1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
 - 2. Color/Pattern: As selected by Architect from manufacturer's full range.
- C. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
 - 1. Steel, Painted: Finished with manufacturer's color as selected by Architect from manufacturer's full range.
 - 2. Aluminum: Finished with manufacturer's standard **clear anodic** finish.

2.5 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum mounted directly to overhead structural support, with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
 - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
 - 1. Multidirectional Carriers: Capable of negotiating intersections without track switches.
- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
 - 1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
 - 2. L Intersections: Allow panels to change 90 degrees in direction of travel.
 - 3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
 - 4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
 - 5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
 - 6. Center carrier stop.
- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- E. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

2.6 ELECTRIC OPERATORS

- A. General: Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-rewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Electrical Characteristics:
 - 1. Horsepower: Manufacturer's standard.
 - 2. Volts: 120.
 - 3. Phase: Coordinate with building's electrical system indicated.
 - 4. Hertz: 60.
- E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and " Stop." Furnish two keys per station.
- F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
 - 1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.
- I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:
 - 1. On storage pocket door, to prevent operation if door is not in fully open position.
 - 2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

3.3 ADJUSTING

- A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust to operate smoothly and easily, without binding or warping.
- C. Verify that safety devices are properly functioning.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102239

SECTION 102800 - TOILET, BATH, AND LAUNDRY 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. Public-use washroom accessories.
 - 2. Public-use shower room accessories.
 - 3. Private-use bathroom accessories.
 - 4. Warm-air dryers.
 - 5. Childcare accessories.
 - 6. Underlavatory guards.
 - 7. Custodial accessories.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE/PRIVATE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

- B. Dispenser/Waste Receptacle:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
- 2. Description: Unit with removable waste receptacle.
- 3. Mounting: Semirecessed.
 - a. Designed for nominal 6-inch wall depth.
- 4. Minimum Waste-Receptacle Capacity: 12 gal..
- 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- 6. Liner: Reusable, vinyl waste-receptacle liner.
- 7. Lockset: Tumbler type for waste receptacle.

- C. Grab Bar:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
- 2. Mounting: Flanges with concealed fasteners.
- 3. Material: Stainless steel, 0.05 inch thick.

- a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
- 4. Outside Diameter: 1-1/4 inches.
- 5. Configuration and Length: As indicated on Drawings.

D. Mirror Unit:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AJW Architectural Products.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
- 2. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Welded and ground smooth.
- 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- 4. Size: As indicated on Drawings.

2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Buckaroos, Inc.
 - b. Plumberex Specialty Products, Inc.
 - c. Truebro by IPS Corporation.
- 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
- 3. Material and Finish: Antimicrobial, molded plastic, white.

2.4 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Mop and Broom Holder:

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

- b. American Specialties, Inc.
- c. Bobrick Washroom Equipment, Inc.
- d. Bradley Corporation.

- 2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
- 3. Length: 36 inches.
- 4. Hooks: Four.
- 5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
- 6. Material and Finish: Stainless steel, No. 4 finish (satin).

- a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
- b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.5 MATERIALS

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

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. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semi-recessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - 1. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.

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

- a. Fire-End & Croker Corporation.
- b. JL Industries, Inc.; a division of the Activar Construction Products Group.
- c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc
- d. Larsens Manufacturing Company.

- B. Cabinet Construction: Nonrated] 1-hour fire rated.

- 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

- C. Cabinet Material: Stainless-steel sheet.

- 1. Shelf: Same metal and finish as cabinet.

- D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

- 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

- E. Cabinet Trim Material: Stainless-steel sheet.

- F. Door Material: Stainless-steel sheet.

- G. Door Style: Vertical duo panel with frame.

- H. Door Glazing: Tempered float glass (clear).

- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

- 1. Provide recessed door pull and friction latch.
- 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

- J. Accessories:

- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
- 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

- a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.

K. Materials:

1. Stainless Steel: ASTM A 666, Type 304.
2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. 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.

2.5 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated
 - 1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire End & Croker Corporation
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc
 - d. Larsen's Manufacturing Company
2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 3-A:40-B:C, 6-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION: 105300- ALUMINUM CANOPY

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work in this section includes furnishing and installation of roll-formed aluminum cantilevered style canopies.
- B. Related Items and Considerations
 - 1. Flashing of various designs may be required. Generic flashing. Specialty flashing to be supplied by installer.
 - 2. Determine wall construction, make-up and thickness.
 - 3. Ensure adequate wall condition to carry canopy loads where required.
 - 4. Consider water drainage away from canopy where necessary.
 - 5. Any necessary removal or relocation of existing structures, obstructions or materials.

1.2 FIELD MEASUREMENT

- A. Confirm dimensions prior to preparation of shop drawings when possible.
- B. If requested, supply manufacturer s standard literature and specifications for canopies.
- C. Submit shop drawings showing structural component locations/positions, material dimensions and details of construction and assembly, signed and sealed by a North Carolina professional engineer.

1.3 PERFORMANCE REQUIREMENTS

- A. Canopy must conform to local building codes.

1.4 DELIVER, STORAGE, HANDLING

- A. Deliver and store all canopy components in protected areas.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mapes Super Lumideck, Hanger Rod Canopy or a comparable product by one of the following:
 - 1. Architectural Fabrication
 - 2. MASA Architectural Canopies

3. Mitchell Metals
 4. SkyScape Architectural Canopies
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Mapes Cantilever or a comparable product by one of the following:
1. Architectural Fabrication
 2. MASA Architectural Canopies
 3. Mitchell Metals
 4. SkyScape Architectural Canopies

2.2 MATERIALS

- A. Decking shall consist of an interlocking roll-form W style pan (.078" aluminum).
- B. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown on Drawings.
- C. Fascia shall be standard extruded 8" J style.

2.3 FINISHES

- A. Finish type shall be -- Class II Clear Anodized.

2.4 FABRICATION

- A. All canopies are shipped in preassembled sections for ease of installation.
 1. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.
- B. Decking shall be designed with interlocking roll-formed aluminum members.
- C. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Front Scupper.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Confirm that surrounding area is ready for the canopy installation.
- B. Installer shall confirm dimensions and elevations to be as shown on drawings.
- C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

3.2 INSTALLATION

A. Installation shall be in strict accordance with manufacturer s shop drawings. Particular attention should be given to protecting the finish during handling and erection.

3.3 After installation, entire system shall be left in a clean condition.

END OF SECTION 105300

SECTION 119000 – WELDING BOOTHS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welding Booth Pairs with integrated Filtration System.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings:** For Welding Booths.

1. Include plans, elevations, sections, and attachment details.
2. Indicate details for anchoring welding booths to permanent building construction including locations of blocking and other supports.
3. Indicate locations and types of service fittings together with associated service supply connection required.
4. Indicate electrical connections, and locations of access panels.
5. Include roughing-in information for mechanical, plumbing, and electrical connections.
6. Show adjacent walls, doors, windows, other building components, and other equipment. Indicate clearances from the above items.
7. Include layout of welding booths in relation to lighting fixtures and air-conditioning registers and grilles.

- C. Samples:** For exposed metal panels, curtains.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.**

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.**

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.7 SOURCE QUALITY CONTROL

- A. The system shall be utilized for welding smoke removal. The system shall be a self-contained unit consisting of a collector housing, two welding booths, motor/blower system, four filter cartridges and an on-line automatic pulse filter cleaning system. The specifications listed in the following sections shall be adhered to for the system requirements.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain welding booth and filtration system from single manufacturer.
- B. efficiency of hoods to be 90 percent minimum.

2.2 WELDING STATION

- A. Description: The system” shall consist of two welding booths with a single air filtration unit. One air filtration unit shall be integrated and inseparable from one of the booths.
 - 1. The booths shall have the ability to be placed in a side-by-side configuration or a back-to-back configuration. The booth without the air filtration system shall have the ability to be placed on the left, right, or back side of the booth with the integrated air filtration system.
 - 2. The configurations shall be bolted together and retain the ability to change configurations.
- B. Housing:
 - 1. The system shall be constructed of 12-gauge steel with a welded body.
 - 2. The system shall have a powder coated exterior and interior finish.
 - 3. The system shall have an enclosed workspace for each booth as indicated on the Drawings.
 - 4. The system shall have a height as indicated on the Drawings.
 - 5. Each booth shall utilize a back draft source capture filtration design consisting of two horizontal slots.
- C. Features:
 - 1. The workspace in each booth shall be illuminated using dust-tight LED overhead lights fed from a 120VAC single-phase integrated transformer.
 - 2. Each booth shall utilize back draft ventilation with removable and replaceable metal mesh spark arrestors.
 - 3. Provide built-in acoustical lining in the blower compartment.
 - 4. System shall utilize an air reservoir connected directly to the valves. The air reservoir shall have the ability to be connected to an air line regulated at 90 PSI using a 1” NPT connection.

5. System shall have a sound dba rating so that conversation can be conducted in front of the booth; 60-74 dBa.
6. System shall be configured for electrical connections of 460VAC, 230VAC, or 208VAC three-phase power.

D. Filtrations:

1. The system shall utilize vertically mounted cartridge type filters.
2. The filters shall have an SAE 726J initial filter efficiency of 99%, and an overall filter efficiency of 99.9% using AC fine dust.
3. The filters shall have an ASHREA standard 52-76 initial atmospheric dust spot efficiency of 40%, with an average atmospheric dust spot efficiency of 93%, and an average synthetic dust weight arrestance of 100%.
4. The system shall utilize four fire retardant, 80/20 cellulose/polyester filter cartridges. Each of these filters shall provide 226 square feet of filter media.
5. The system shall utilize two metal mesh spark arrestors in each booth. The spark arrestors shall be 23.5" W x 23.5" H x 1.875" D.
6. The system shall utilize "True Down Flow Technology" patented filtration technology.
7. The system shall utilize four vertically mounted cellulose/polyester filters with an 80/20 mixture.
8. The system shall have a self-cleaning filter design.
9. The system shall utilize reverse pulse cleaning technology. The reverse pulse cleaning must pulse air back through the filters to dislodge the filtered dust into a dust tray.
10. The system shall have the ability to pulse on demand or automatically.
11. The system shall utilize a programmable pulse controller which has an integrated pressure differential display.
12. The system shall be set up to perform a shut down pulse sequence automatically if the pressure differential across the filters reaches a set value. The filters shall be pulsed when the motor is stopped.
13. The system shall be set up to perform an operating pulse sequence automatically if the pressure differential across the filters reaches a set value. The filters shall be pulsed when the motor is running.
14. The system shall utilize a pulse controller which measures the pressure differential across the filters and controls two 1" valves. The valves must be actuated independently.
- 15.

E. Electrical:

1. The system shall utilize an integrated disconnect switch which disconnects all power to unit.
2. The system shall utilize a momentary on/off button located on the front of the air filtration portion of the booth.
3. The system shall utilize a programmable pulse controller, which is operated on 120VAC single-phase power fed from an integrated transformer.
4. The system shall utilize a motor contactor, which has a hold down coil actuated by 120VAC single-phase power fed from an integrated transformer.
5. The system shall have a standard VFD

F. Motor/ Blower Package:

1. The motor size shall be 5 HP running at 3450 RPM at 60Hz supply power.
2. The blower shall be a backward incline, airfoil high efficiency plug-type blower.
3. The system shall utilize a direct drive method for motor blower design. No gearing or pulley system shall be utilized.
4. The system shall achieve 4000 CFM using the specified motor and blower at a pressure drop of 3 inches of water.

2.3 FABRICATION

- A. General: Assemble Welding Stations in factory to greatest extent possible. Disassemble only as necessary for shipping and handling limitations.

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 fume hoods.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install Welding Stations according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

3.3 ADJUSTING AND CLEANING

- A. Clean finished surfaces, touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 115313

SECTION 122113 - HORIZONTAL LOUVER BLINDS

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. Horizontal louver blinds with aluminum slats.

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, 12 inches long.
- C. Samples for Initial Selection: For each type and color of horizontal louver blind.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type and color of horizontal louver blind indicated.
 - 1. Slat: Not less than 12 inches long.
 - 2. Tapes: Full width, not less than 6 inches long.
 - 3. Horizontal Louver Blind: Full-size unit, not less than 16 inches wide by 24 inches long.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CACO, Inc., Window Fashions.
 - 2. Hunter Douglas Contract.
 - 3. Levolor Contract; a Newell Rubbermaid company.
- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.
 - 1. Width: 1 inch.
 - 2. Thickness: Not less than 0.006 inch.
 - 3. Spacing: Manufacturer's standard.
 - 4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.
 - 5. Features: Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.
 - 6. Location: Provide one blind per each lite in W-1, W-2, W-3 Windows.
- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.
 - 1. Capacity: One blind per headrail unless otherwise indicated.

2. Ends: Capped or plugged.
 3. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
 4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Clear-plastic wand.
 - c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.
 5. Integrated Headrail/Valance: Curved face.
- D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
1. Type: Manufacturer's standard.
- E. Lift Cords: Manufacturer's standard.
- F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
1. Type: Braided cord.
- G. Valance: Manufacturer's standard.
- H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
1. Type: End.
 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
- I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- J. Colors, Textures, Patterns, and Gloss:
1. Slats: As selected by Architect from manufacturer's full range.
 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 1. Locate so exterior slat edges are not closer than 2 inches from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.
 2. Install mounting and intermediate brackets to prevent deflection of headrails.
 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.
 4. Provide full blind coverage on Windows W1 through W6 including top and bottom lites of windows.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that horizontal louver blinds are without damage or deterioration at time of Project Acceptance.

- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Project Acceptance.

END OF SECTION 122113

SECTION 123661 - SIMULATED STONE COUNTERTOPS

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. Solid-surface-material countertops and backsplashes.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS (CTOP-1)

- A. Basis of Design: Wilsonart
 - 1. Ceaserstone

2. Corian
3. Dekton

B. Location: Typical countertop, unless noted otherwise.

C. Color: As chosen by architect's full range of manufacturers products.

D. Configuration: Provide countertops with the following front and backsplash style:

1. Front: 3/4-inch bullnose. Waterfall Edge.
2. Backsplash: Radius edge with 3/8-inch radius.
3. Endsplash: Matching backsplash.

E. Countertops: 1/2-inch-thick, solid surface material with front edge built up with same material.

F. Backsplashes: 1/2-inch-thick, solid surface material.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOPS (CTOP-2)

A. Basis of Design: Dekton, Trilium Tech

1. Ceaserstone
2. Corian
3. Wilsonart

B. Location: Breakroom 101M.

C. Color: As chosen by architect's full range of manufacturers products.

D. Configuration: Provide countertops with the following front and backsplash style:

1. Front: 3/4-inch bullnose. Waterfall Edge.
2. Backsplash: Radius edge with 3/8-inch radius.
3. Endsplash: Matching backsplash.

E. Countertops: 0.8-inch-thick, solid surface material with front edge built up with same material.

F. Backsplashes: 0.8-inch-thick, solid surface material.

2.3 Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

A. Fabricate with loose backsplashes for field assembly.

2.4 COUNTERTOP MATERIALS

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. Adhesives: Adhesives shall not contain urea formaldehyde.

C. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

1. Type: Provide Standard Type unless Special Purpose Type is indicated.

2. Colors and Patterns: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION 123661

SECTION 124816 - ENTRANCE FLOOR GRILLES

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 recessed floor grilles and frames.

1.3 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor grilles and frames.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for entrance floor grilles and frames.
- B. Shop Drawings:
 - 1. Items penetrating floor grilles and frames, including door control devices.
 - 2. Divisions between grille sections.
 - 3. Perimeter floor moldings.
- C. Samples: For the following products, in manufacturer's standard sizes:
 - 1. Floor Grille: Assembled section of floor grille.
 - 2. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor grilles and frames to include in maintenance manuals.

1.6 FIELD CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babcock-Davis.
 2. Balco, Inc.
 3. C/S Group.
 4. JL Industries, Inc.; a division of the Activar Construction Products Group.
 5. Kadee Industries, Inc.

2.2 ENTRANCE FLOOR GRILLES, GENERAL

- A. Structural Performance: Provide floor grilles and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:
1. Uniform floor load of 300 lbf/sq. ft..
 2. Wheel load of 350 lb per wheel.
- B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 FLOOR GRILLES

- A. General: Provide manufacturer's standard floor-grille assemblies consisting of treads of type and profile indicated, interlocked or joined together by cross members, and with support legs (if any) and other components needed to produce a complete installation.
- B. Aluminum Floor Grilles: Provide manufacturer's standard floor grilles with extruded members, top-surfaced tread rails, and as follows:
1. Tread Rails: Extruded-aluminum tread rails.
 - a. Aluminum Color: Clear.
 2. Tread Rail Spacing: 1-1/2 inches o.c. with 1/8- to 3/16-inch-wide openings between treads.
 3. Top Surface: Serrated vinyl cap with UV stabilizer and antifungal additive.
 - a. Top Surface Color: Match tread rail.
 4. Grille Size: As indicated.
- C. Lockdown: Manufacturer's standard.

2.4 FRAMES

- A. Provide manufacturer's standard frames of size and style for grille type, for permanent recessed installation in subfloor, complete with installation anchorages and accessories. Unless otherwise indicated, fabricate frame of same material and finish as grilles.

2.5 SUPPORT SYSTEM

- A. Level Bed Applications: Provide manufacturer's standard, vinyl cushion support system.
- B. Drainage Pit Applications: Provide manufacturer's special deep-pit frame and support extrusion system with intermediate support beams, sized and spaced as recommended by manufacturer for indicated spans and equipped with vinyl support cushions.

2.6 MATERIALS

- A. Aluminum Sheet: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15.
- B. Extruded Aluminum: ASTM B221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52 as standard with manufacturer.

2.7 FABRICATION

- A. Shop fabricate floor grilles to greatest extent possible in sizes as indicated. Unless otherwise indicated, provide each grille as a single unit; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.
- B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- C. Coat surface of aluminum in contact with cementitious materials with manufacturer's standard protective coating.

2.8 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, size, minimum recess depth, and other conditions affecting installation of floor grilles and frames.
- B. Examine roughing-in for drainage piping systems to verify actual locations of piping connections before floor grille and frame and drain pan installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install recessed floor grilles and frames to comply with manufacturer's written instructions at locations indicated and with top of floor grilles and frames in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set floor-grille tops at height for most effective cleaning action. Coordinate top of floor-grille surfaces with doors that swing across grilles to provide clearance under door.

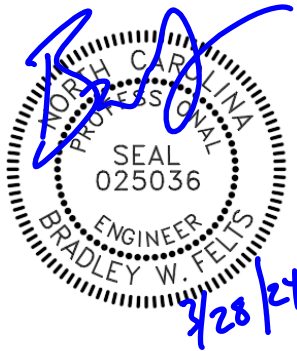
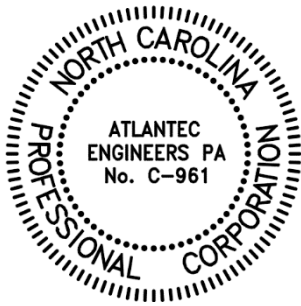
3.3 PROTECTION

- A. After completing frame installations, provide temporary filler of plywood or fiberboard in floor-grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Project Acceptance.

END OF SECTION 124816

FIRE SPRINKLER SPECIFICATIONS INDEX

210500	GENERAL (FIRE SPRINKLER) PROVISIONS
210513	ELECTRICAL WORK IN FIRE SPRINKLER CONTRACT
210523	FIRE SPRINKLER SYSTEM PIPING
210529	PIPE HANGERS AND SUPPORTS
213000	FIRE PUMPS AND CONTROLLERS



SECTION 210500 – GENERAL (FIRE SPRINKLER) PROVISIONS

A. GENERAL

1. Scope of Work
 - a. The Sprinkler Contractor shall be licensed for sprinkler work.
 - b. The Sprinkler Contractor shall provide all materials and labor necessary to install a complete and operating sprinkler system in accordance with the Engineering Drawings and as specified herein.
2. Quality Assurance
 - a. All work shall be in accordance with State Building Codes, National Fire Protection Association and all applicable codes.
 - b. The Notice to Bidders, Instructions to Bidders, General Conditions, and Supplementary General Conditions are a part of these specifications.
 - c. Any inspection and test charges required for the sprinkler work by approving authorities and Owners and any permits needed for installation of a complete system shall be secured and paid for by the Sprinkler Contractor.
 - d. Where the words "Approved", "Approval", or "Approved Equivalent" appear, it is intended that items other than the model number specified shall be subject to approval of the Engineer.
 - e. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall require and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
 - f. All material and equipment that the Contractor proposes to substitute in lieu of those specified, shall be submitted to the Engineer ten (10) days before the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required. Items that are submitted for approval after this date will not be accepted.
 - g. The Sprinkler Contractor shall refer to the General Conditions for provisions of temporary utilities required under this Contract.
 - h. All work shall be performed in accordance with U. S. Department of Labor, Occupational Safety and Health Standards.
 - i. The entire system will be accepted as a unit. There will be no partial acceptance.
 - j. The Owner shall provide heat in the building to protect the wet pipe system after acceptance of the system and provide all fire extinguishers.
3. Submittals
 - a. See General and Supplementary General Conditions.

- b. Within ten days after notification of the award of contract and written notice to begin work the Contractor shall submit to the Architect/Engineer for approval, a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Four sets of submittal data shall be provided for approval.
 - c. Each submittal shall bear the approval of the Contractor indicating he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitutions for specified items. Acceptance for approval shall be in writing from the Engineer.
 - d. Shop drawings and data sheets shall provide all pertinent information for proper evaluation of each item. The drawings are diagrammatic only and are not intended to show minor details and exact locations. Locations of pipes, ducts, electrical raceways, panels, equipment, light fixtures, ceiling diffusers, etc., shall be reviewed, and anticipated interferences shall be coordinated with other Prime Contractors prior to installation. Lines, whose elevation cannot be changed, shall have the right-of-way, and larger lines shall have the right-of-way over smaller lines. Shop drawings shall show all principal dimensions, "tie-in" dimensions, sizes and locations.
 - e. The Contractor shall submit to the Engineer a set of accurately marked plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these As-Built Plans.
 - f. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions, parts lists, electrical circuit wiring diagrams, all submittal data and sufficient manufacturer's literature to operate and maintain all equipment.
 - g. The Contractor shall submit to the Owner all certificates required for operating system in compliance with state and federal regulations.
4. Product Delivery, Storage and Handling
- a. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner. Designated areas for material storage will be established by the Owner, and each Contractor will be responsible for maintaining his own area.
 - b. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
 - c. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
5. Work Conditions and Coordination
- a. The Contractor shall review the plans of all other Prime Contractors on the job and inform them of anticipated areas of conflict prior to installation of fire protection system.
 - b. The Contractor shall review the electrical requirements for the equipment provided and establish points of connection and the extent of electrical work to be provided in

his Contract. All electrical work shall be performed by a licensed electrical contracting firm.

- c. The Contractor will be responsible for the final electrical connections to all equipment installed as part of his contract. Unless otherwise noted, this Contractor shall wire from his equipment to disconnect switches, junction boxes, or panelboard circuit breakers as provided by the Electrical Contractor.
 - d. Electrical work by this Contractor shall be in accordance with all state and national codes, and as specified in Division 16 contained herein.
 - e. Pipe sleeves and chases required for the installation of a complete fire protection system shall be furnished by this Contractor, and he shall be responsible for coordinating the location and correct number of all required openings. The Contractor will be responsible to the General Contractor for coordinating this work with his schedule and will not cause him any undue hardship or loss of time.
 - f. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.
6. Guarantee
- a. Contractor will provide extent and length of warranty and guarantee for all products with his submittals. If no warranties are available or offered, it shall be understood that the Contractor shall guarantee and warrant all materials and labor done under his contract for 12 months from the date of acceptance.
 - b. Where extended warranties or guaranties are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Owner.

B. PRODUCT

1. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the Contractor's expense.
2. The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core.
3. All materials, products and equipment and components thereof which make up a complete fire protection system, shall be such as appear on the Fire Underwriters Equipment List of the Underwriters Laboratories, Inc.

C. EXECUTION

1. Inspection

- a. This Contractor shall examine all areas of completed work prior to installation of the fire protection systems and insure that no defects or errors are present which would result in the poor application or installation of subsequent work.
 - b. It is the responsibility of this Contractor to coordinate all work performed by others for this Contractor. Upon inspection, should errors or omissions be found, it will be the responsibility of this Contractor to resolve the problem at no cost to the Owner.
2. Installation
- a. All work shall be performed in a manner indicating proficiency in the trade.
 - b. All pipes, conduit, etc., shall be either parallel to the building walls or plumb where installed in a vertical position, unless otherwise noted, and shall be concealed when located in architecturally finished areas.
 - c. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
 - d. All patching shall be done in such a manner as to restore the areas or surfaces to match existing finishes.
 - e. This Contractor shall familiarize himself with the method and schedule of installation of poured concrete floors and walls. He shall lay out his work in advance and furnish all sleeves and opening locations to the General Contractor for installation. This Contractor shall provide and install all inserts and hangers required to support his equipment, pipes, conduit, etc.
 - f. All piping and conduit shall be accurately roughed in according to manufacturer's installation dimensions so that no offset adaptors, flexible connections or other imprecision not required by the manufacturer are necessary. All incorrect work shall be torn out and corrected and walls and floors patched at no expense to the Owner.
 - g. Items such as alarms, valves, test connections, drains, etc., shall be accessible for operating, servicing, maintaining and repairing. Those which are installed in unsuitable locations shall be relocated as directed by the Architect/Engineer at no cost to the Owner.
 - h. Connections to water, soil and waste lines shall be made at locations shown on the drawings.
3. Performance
- a. This Contractor shall perform all excavation and backfill operations necessary for installation of his work.
4. Erection
- a. All support steel, angles, channels, pipes or structural steel studs and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided and installed by this Contractor, unless otherwise noted.
5. Field Quality Control
- a. Testing and Flushing
 - 1) Upon completion of work, inspection and tests shall be made by the Contractor's representative and witnessed by an Owner's representative. All

defects shall be corrected and system left in service before a final certificate is issued. The NFPA Contractor's Material and Test Certificate shall be completed and signed by both representatives. Copies shall be prepared for approving authorities, Owner and Contractor.

- 2) The entire fire protection system, including yard piping, shall be hydrostatically tested at not less than 200 pounds per square inch pressure for two hours or at 50 pounds per square inch in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.
- 3) The inside sprinkler piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic pressure test.
- 4) The yard piping test shall be made before the joints are covered in order that any leaks may be readily detected. Leakage shall not exceed 2 quarts per hour per 100 joints. It is important to backfill the trench between joints before testing to prevent movement of pipe. The yard piping shall be flushed before connecting to the internal sprinkler system.
- 5) Instruments, specialties and equipment subject to damage shall be isolated during tests.
- 6) Prior to final acceptance, each control valve shall be closed and opened under pressure, to insure proper operation.
- 7) Test of drainage facilities shall be made while the control valve is wide open. The main drain valve shall be opened and remain open until the system pressure stabilizes.
- 8) Final report forms shall be prepared, delivered to and approval obtained from local authorities, IRI, and any other agency having approval authority and delivered to the Owner. Contractor's Certificate covering materials and tests shall be prepared and delivered to the Owner.

END OF SECTION 210500

SECTION 210513 – ELECTRICAL WORK IN FIRE SPRINKLER CONTRACT

A. GENERAL

1. This Contractor shall be responsible for the final electrical and the entire control system and control connections to all equipment installed as part of his contract.
2. Wiring from disconnect switches, junction boxes, panel board circuit breakers, etc. up to mechanical equipment shall be by the electrical contractor. Final electrical connections to mechanical equipment shall be by this contractor.
3. All power and control wiring shall be in conduits.
4. All electrical work shall be performed by a licensed electrician.
5. All electrical work shall be in accordance with the State Building Code and all its supplements and the latest edition of the National Electrical Code.

B. PRODUCT

1. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
2. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
3. All conductors and conduits shall be sized as noted on the plans or as required per NEC.

C. EXECUTION

1. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
2. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid- Tite" conduit. Connection to other equipment shall be made with rigid conduit.
3. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

SECTION 210523 –FIRE SPRINKLER SYSTEM PIPING

A. GENERAL

1. The Sprinkler Contractor shall provide all materials and labor for the installation and make operational a complete sprinkler system.
 - a. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
2. The sprinkler system shall meet all NFPA Standards and approval by governing authorities, and all other authorities having approval jurisdiction shall be received prior to and after installation.
3. All materials shall be new, and all materials, products and equipment and components thereof shall be such as appear on the Fire Underwriters' Equipment List of the Underwriters' Laboratories, Inc.
4. All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
5. The Contractor shall provide the Owner with instruction charts describing operation and proper maintenance of sprinkler devices, and a copy of the publication, NFPA 25-2014, entitled Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems.
6. Before asking final approval of automatic sprinkler equipment by the authorities have jurisdiction, the Contractor shall furnish a written statement to the effect that the work covered by his Contract has been completed and tested in accordance with the approved specifications and drawings.
7. See Section 210500, Item C, EXECUTION, Paragraph 5, Field Quality Control for Acceptance Tests Requirements.
8. Testing of all piping shall be made in the presence of the Engineer or designated representative of the Owner. No piping shall be covered or put into operation before such testing has been approved.

B. PRODUCT

1. Piping
 - a. Piping 2 1/2" and larger shall be schedule 10, and piping 2 " and smaller shall be schedule 40, black steel pipe conforming to ASTM Specification A795. Other type piping may be submitted for approval only if listed, and it meets the standards cited in NFPA.
 - b. Standard weight welding fittings shall be used and shall conform to ANSI B16.11.
 - c. Screwed fittings shall be malleable iron, 150 pounds s.w.p. with banded pattern conforming to ANSI B16.3.

- d. Standard riser plate signage shall be provided on each system riser.
- e. Grooved end fittings shall be ductile iron and conform to ASTM A536, Grade 65-45-12. Short-pattern, with flow equal to standard pattern fittings.
- f. Grooved Joint Couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12, with pressure-responsive elastomer gasket conforming to ASTM D-2000, and zinc-electroplated carbon steel bolts and nuts conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476.
 - 1) Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA-13. Installation ready rigid coupling for direct stab installation without field disassembly.
 - a) Couplings shall be fully installed at visual pad-to-pad offset contact. Tongue and recess type couplings, which require the use of a torque wrench to achieve the exact required gap between housings, are not permitted.

2. Sprinkler Heads

- a. Only listed sprinkler heads shall be used. Sprinkler heads shall not be altered in any respect, nor have any type of ornamentation or coatings applied after shipment from the place of manufacture.
- b. Sprinkler body shall be integrally cast with a hex shaped wrench boss to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss. (Sprinklers shall not contain rubber O-rings.)
- c. Guards shall be furnished wherever heads will be subject to damage. Provide guard on heads in janitor's closet.
- d. Guards and escutcheons shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
- e. The Contractor shall provide the Owner a cabinet containing a minimum of 6 spare sprinklers of each type used in the installation. A special sprinkler wrench shall also be provided to be used in the removal and installation of sprinklers. Mount cabinet adjacent to riser.
- f. Where possible, all sprinkler heads shall be trimmed with materials to allow ceiling tile replacement.
- g. Multiple-Use Flexible Drop System: In lieu of rigid pipe offsets or return bends for sprinkler drops may be used to locate sprinklers as required by final finished ceiling tiles and walls. Head and flexible piping shall bear UL 2443 listing.
 - 1) The drop shall include a UL approved 304 stainless steel braided hose with a bend radius to 2" to allow for proper installation in confined spaces. The hose shall be limited to 60". Hose diameter shall have a 1" true bore internal diameter.

- 2) Union joints shall be provided for ease of installation.
 - 3) The flexible drop shall be permanently attached to the ceiling. Attach to the ceiling grid using a one-piece open gate bracket and tamper resistant screws. The bracket shall allow installation before the ceiling tile is in place.
 - 4) The braided drop system is UL listed and FM Approved for sprinkler services to 175 psi (1206 kPa).
 - 5) Hose shall connect to side or top of branch piping.
 - 6) Hydraulic calculations shall be based on actual pressure drop losses published by the manufacturer.
3. Sprinkler Alarms
- a. Alarm check valve of the approved type with water motor alarm gong, riser trim, drain valves and riser lines shall be located at the main system control valve as indicated on the Drawings.
 - 1) Valve internal components shall be replaceable without removing the valve from the installed position.
 - b. Water flow switches are to be furnished and installed by the Sprinkler Contractor.
 - c. Wiring from flow switches and alarm valves to fire alarm control panel shall be by Electrical Contractor.
4. Gauges
- a. Approved pressure gauges shall be installed as indicated on the Drawings. The gauge connection shall be equipped with a shut-off valve and with provision for draining.
 - b. The pressure gauges shall be of approved type and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal and shall be located where they will not be subject to freezing.
5. Fire Department Connections
- a. Approved equipment shall be by Crocker, Seco, Standard, W. D. Allen, or Elkhart, or approved equivalent.
 - b. Sprinkler alarms shall be installed as required by NFPA or local authorities for a complete sprinkler system.
 - c. Wiring from tamper switches and flow switches to fire alarm control panel shall be by the Electrical Contractor.
6. Valves
- a. Shut-off valves shall be butterfly type with grooved ends or 125# flanges. The valve seat shall be pressure responsive, and the stem shall be offset from the disc centerline to allow complete 360 degree circumferential seating. Valve

- shall be provided with a weatherproof actuator with two SPDT supervisory switches with position indicating tab.
- b. Check valves shall be grooved end or flanged type with spring-assist. Valve shall be capable of being mounted vertically or horizontally.
 - c. Inspector's Test Valve: Provide inspector's test valve and piping as shown on the Drawings.
 - d. Standard design identification signs shall be provided on all control drain, test and alarm valves.

C. EXECUTION

1. Pipe 2" and smaller shall have screwed joints.
2. Pipe 2 1/2" and larger shall be welded or grooved ends. Welding of pipe shall be in accordance with NFPA 13, Chapter 3-3.12.4.
3. Welding ties or weldolets shall be used.
4. No "stub-in" shall be permitted.
5. When risers are 3" and larger in size, a flange joint shall be used at the riser where required.
6. Screwed unions shall not be used on pipe larger than 2". Couplings and unions of other than screwed type shall be of types approved specifically for use in the sprinkler systems.
7. Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
8. A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe, except hexagonal or face bushings may be used in reducing the size of the openings of fittings when standard fittings of the required size are not available.
9. Hangers supporting horizontal piping shall be installed and spaced in accordance with NFPA 13, Chapter 3-3.14.
10. Sleeves shall be provided wherever pipes pass through walls, floors, and ceilings. Sleeves shall be schedule 40, black steel, 1/2" in diameter larger than the pipe or insulation on the pipe. Sleeves through wall and ceiling shall be flush. Sleeves through floors shall extend one inch above finished floor. Sleeves in exterior walls shall be caulked and made watertight. Pipes passing through sleeves shall be painted with a rust inhibiting paint. Pipes passing through fire walls or floors shall be sealed to conform to Underwriters' Laboratories requirements.

11. Installation of hangers and inserts shall be coordinated with all other Contractors on a priority basis. Each Contractor shall be responsible for providing all inserts, hangers, and rods necessary for the installation of his work.
12. Spacing, location and position of sprinkler heads and piping are approved on plans and shall be in accordance with minimum standards set forth in NFPA 13, Chapter 3.
13. All sprinkler heads, unless otherwise noted, will be centered in ceiling tiles.
14. All sprinkler heads, unless otherwise noted, will be installed on a swing connection.
15. Do not install sprinklers that have been dropped or show a visible loss of fluid. Never install sprinklers with cracked bulbs.
16. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.
17. All piping tests for the sprinkler system shall be in accordance with NFPA 13, Chapter 1-1.11.3. A Contractor's Material and Test Certificate Part "C" will be filled out for each riser by the Contractor and signed with copies prepared for approving authorities, Owner, and Architect/Engineer. Any leaks that occur shall be repaired and another test started. All defects shall be corrected and the system left in service before the Contractor leaves the job.

END OF SECTION 210523

SECTION 210529 – PIPE HANGERS AND SUPPORTS

A. GENERAL

1. This Section includes hangers and supports, etc. as may be required to provide a complete sprinkler piping system.
2. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.

B. PRODUCT

1. Piping shall be as stated in Section 210523.
2. Hangers and Supports shall be as follows:

Concrete Inserts	Fig. B2500
Hanger Rod	Fig. B3205
Riser Clamp	Fig. B3373
Hanger	Fig. B3100
Pipe Saddles	Fig. B3160
Insulating Protector	Fig. B3151
Rod Ceiling Plate	Fig. B3199
Beam Clamps	Fig. 3050
Offset Clamps	Fig. B351L
Roller Hanger	Fig. B3110

Figure numbers given above are devices as manufactured by B-Line Systems, Inc.

C. EXECUTION

1. Hangers supporting horizontal piping shall be spaced in accordance with NFPA 13.
2. Hangers shall be provided at each change in direction. Vertical risers shall be supported at each floor, 5 feet on center and/or at changes in direction of pipe.
3. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be schedule 40, black steel, 1/2" 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 in exterior walls shall be caulked and made watertight.

SECTION 213000 – FIRE PUMPS AND CONTROLLERS

A. GENERAL

1. RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specifications, apply to this Section.

2. GENERAL DESCRIPTION

- a. This Section includes electric-drive, centrifugal fire pumps and the following:
 - i. Full-service fire-pump controllers.
 - ii. Fire-pump accessories and specialties.
 - iii. Pressure-maintenance pumps, controllers, accessories, and specialties.
 - iv. Alarm panels.
 - v. Flow meter systems.
- b. The systems shall be supplied from a new fire pump. Contractor shall provide fire pump that is designed to provide adequate flow and pressure to satisfy the sprinkler system demand. A minimum rated fire pump of 750 gpm at 50 psi is anticipated. Contractor shall be responsible for sizing the fire pump to satisfy the sprinkler system demand.
- c. Fire pump is to be located in the fire pump room as shown on the drawings.
- d. The water supply to the fire pump shall be based flow tested listed on the plans. Contractor shall verify water supply information by conducting hydrant flow tests.
- e. The work shall be subject to the terms and conditions contained within the contract documents.
- f. All work shall be performed in accordance with these Specifications. No modifications to these Specifications will be accepted without the expressed written approval of the Owner. It is the Contractor's responsibility to document Owner's approval of any such modifications prior to the execution of work.
- g. Coordinate work with other trades working on the project.
- h. Fire Pump to be monitored by the fire alarm system. Coordinate connections to fire alarm system with fire alarm system contractor. Refer to electrical drawings for power connections. Coordinate with electrical contractor for power connections.

3. INTENT OF SPECIFICATONS

- a. It is intended that the work performed pursuant to these Specifications be complete in every respect, resulting in a system installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and Underwriters Laboratories, Inc. (ULI) listings.
- b. It is further intended that upon completion of this work, the Owner be provided with:

- i. Complete information and drawings describing and depicting the entire system as installed, including all information necessary for maintaining troubleshooting and/or expanding the systems at a future date.
- ii. Complete documentation of systems testing.
- iii. Certification that each entire sprinkler system has been inspected and tested; is installed entirely in accordance with the applicable codes, standards, manufacturer's recommendations and ULI listings; and is in proper working order. Contractor shall use "Contractor's Material and Test Certificates for Aboveground Piping".
- iv. Fire pump controller shall be listed together with the selected fire pump.

4. WORK INCLUDED

- a. Provide electrically driven fire pump with rated capacity that is designed to satisfy sprinkler system demand. Fire pump assembly to include pump controller, jockey (pressure maintenance pump) and associated controller, fire pump test header, city bypass and all other associated equipment to comply with the NFPA standards.
- b. Work shall include all required interconnecting wiring for a fully operational pump installation.
- c. Provide all new drains necessary to drain and test the fire pump.
- d. Prepare and submit shop drawings, record drawings and other submittals required herein.
- e. Install fire protection system identification signs in accordance with NFPA 20.
- f. Perform an acceptance test of the new fire pump in accordance with WTCC requirements. The manufacturer's representative shall also attend all fire pump testing. The Contractor shall be responsible for carrying out required tests. Separate tests may be required by the Engineer and Owner.
- g. Guarantee all new equipment and systems during installation and for a two year period after final acceptance of the work by the Architect or Engineer.
- h. Obtain all approvals required for the work of this section from the project insurer, Architect or Engineer, and the Owner.
- i. Pay all fees required to obtain permits or approval of this work.

5. QUALITY ASSURANCE

- a. All equipment and installation to be in accordance with recommendations of and reviewed by State Construction Office, Architect/Engineer and the owner.
- b. All work and materials shall conform to all Federal, State, and local codes and regulations governing this installation.
- c. With exceptions as specified and/or indicated on the drawings or in the specifications, apply, install, connect, erect, use, clean and condition manufactured articles, materials and equipment per manufacturer's current printed information. Keep copies of such printed recommendations and NFPA pamphlets at job site and make them available to the Architect/Engineer.

- d. Source Limitations: Obtain fire pumps, pressure-maintenance pumps, and controllers through one source from a single manufacturer for each type of equipment.
- e. Retain first paragraph below to allow drawing details based on one manufacturer's product to establish requirements and still allow competition. Coordinate with Division 1 requirements.
- f. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- g. Comply with standards of the WTCC pertaining to materials, hose threads, and installation.
- h. If there is a conflict between the referenced NFPA Standards, Federal, State or local codes and this specification, it shall be the Contractor's responsibility to bring the conflict to the attention of the Architect or Engineer for resolution.
- i. The Contractor shall be responsible for filing all documents, paying all fees and securing all permits, inspection and approvals necessary for conducting this work.
- j. All devices, systems, equipment and materials furnished and installed shall be new and shall be of types or models approved by the Owner, Architect and Engineer for use in systems and occupancies of this type.
- k. Welding materials and labor to conform to ASME code and applicable state labor regulations.

6. REFERENCE STANDARDS

- a. NFPA: National Fire Protection Association, Battery March Park, Quincy, Massachusetts 02269, U.S.A.
 - i. NFPA 13, 2007 Edition - Standard for the Installation of Sprinkler Systems.
 - ii. NFPA 14, 2007 Edition – Standard for the Installation of Standpipe and Hose Systems.
 - iii. NFPA 20, 2007 Edition – Standard for the Installation of Stationary Pumps for Fire Protection.
 - iv. NFPA 24, 2007 Edition – Standard for the Installation of Private Service Mains and Their Appurtenances.
 - v. NFPA 25, 2008 Edition - Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems.
 - vi. NFPA 70, 2008 Edition - National Electrical Code.
 - vii. NFPA 72, 2008 Edition - National Fire Alarm Code. B. Underwriters Laboratories, Inc., (UL) requirements applicable to product listing.
 - viii. Factory Mutual (FM) Systems Approval Guide

7. CONTRACTOR REQUIREMENTS

- a. Contractor shall hold all licenses and obtain all permits necessary to perform work of this type. Copies of the Contractor's licenses shall be provided with bid submittal.
 - b. Contractor shall have at least five (5) years of experience in installation of systems of this type and be familiar with all applicable regulations.
 - c. Contractor shall be regularly engaged in the design, installation, testing and servicing of fire pumps.
 - d. Contractor shall provide a job supervisor who is to be present at all times when work is actively in progress.
 - e. Prior to start of installation, the Contractor shall obtain and submit copies of all licenses, certificates, insurance, and approvals necessary to conduct this work.
 - f. System layout and installation shall be supervised by a licensed NICET Level III sprinkler system technician or fire protection engineer with not less than five (5) years experience with sprinkler system. Shop drawings shall be prepared and engineered. The signature of the engineer constitutes an affidavit that the statements, representations, and information presented in the submittal constitute a complete operational system conforming to applicable state laws and recognized good engineering practices. All field installation work shall be continuously supervised by a NICET Level II or III sprinkler system technician or certified manufacturer representative.
8. BASIS OF DESIGN
- a. NFPA 20 Required pump capacity to be able to accommodate the sprinkler system per contractor design and hydraulic calculations.
9. SUBMITTALS
- a. General Refer to information required in Contract General Requirements.
 - i. All product data shall be submitted under provisions of Division 1.
 - ii. No work shall be performed until shop drawings, calculations and data sheets have been reviewed by Architect/Engineer and State Construction Office. The contractor is solely liable for any work performed prior to this review.
 - iii. The Architect/Engineer on behalf of the Owner shall review and recommend approval/disapproval or take other appropriate action on the Contractor's submittals including shop drawings, samples, documentation and record drawings. This review is to verify conformance to project specifications and design concepts expressed in the contract documents. This action shall be taken with all reasonable promptness as to cause no delay in the work, while allowing adequate time to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details (i.e., dimensions) or for substantiating installation or performance of equipment or systems designed by the Contractor, all of which remain the Contractor's responsibility to the extent required by the contract

documents. The review on behalf of the Owner shall not constitute approval of safety precautions of construction, means, method, techniques, sequences of procedures, approval of a specific assembly of which the item is a part.

- iv. Submittal shall contain all necessary information for the entire system. Partial submittals will not be accepted.
 - v. If submittals, upon single review by the Owner, are found not to conform to the requirements of these Specifications, the Contractor shall be required to resubmit with modifications. Approval of the submittals by the Owner shall, in no case, relieve the Contractor of his responsibility to meet the requirements of this Specification.
 - vi. Work schedule shall comply with the general requirements.
- b. Product Data:
- i. For each type of product indicated. Include rated capacities, certified pump performance curves with each selection point indicated, operating characteristics, and furnished accessories and specialties for each fire pump and pressure maintenance pump.
 - ii. When a data sheet shows more than one product, the proposed product shall be clearly indicated by arrows or other suitable means.
 - iii. Catalog data must have the item or model number to be provided clearly marked and all accessories indicated. Submit literature showing details of each item of equipment. Mark out all inapplicable items. Plainly indicate the intended use of each item shown. Where “multiple choice” items are shown with deletions, Engineer will require the furnishing of the highest quality or most expensive items. Equipment suppliers will mark all data using only black pen. Reviewing Contractors will add additional data or markings using only green pen. Red pen will be reserved for marks added to submittal data by reviewing Architect and Engineer.
- c. Shop Drawings: For fire pumps and drivers, fire-pump controllers, fire-pump accessories and specialties, pressure-maintenance pumps, pressure-maintenance-pump controllers, and pressure-maintenance-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.
- i. The drawings shall be signed and sealed in accordance with the requirements of the Texas Board of Technical Registration.
 - ii. Wiring Diagrams: Power, signal, and control wiring.
- d. Product Certificates: For each type of fire pump and fire-pump controller, signed by product manufacturer.
- i. Source quality-control test reports.
 - ii. Field quality-control test reports.
- e. Operation and Maintenance Data: For fire pumps and drivers, pressure-maintenance pumps, controllers, accessories and specialties, alarm panels, and

flow meter systems to include in emergency, operation, and maintenance manuals.

f. Contractor Record Drawings

- i. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawing prints which shall be marked to show each and every change made to the automatic sprinkler systems from the original approved shop drawings. This shall not be construed as authorization to deviate from or make changes to the shop drawings approved by the Owner without written instruction from the Owner in each case. This set of drawings shall be used only as a record set.
- ii. Upon completion of the work, the record set of prints shall be used to prepare complete, accurate final record drawings reflecting any and all changes and deviations made to the fire pump.
- iii. Upon completion of the work, record drawings shall be submitted to the Architect/Engineer and Owner for review. The number of record drawing sets shall be in accordance with the Contract and other sections of these Specifications.
- iv. Upon review of the record drawings before final approval, one set of reproducible record drawings and the Owner's requested number outlined in the Contract and other section of these Specifications shall be delivered to the Owner and Architect/Engineer for review and approval.
- v. Provide contractor record drawings in electronic format acceptable to the Owner.

10. WORKING CONDITIONS

- a. It shall be the Contractor's responsibility to inspect the job site and become familiar with the conditions under which the work will be performed. Inspection of the existing building may be made by appointment with the Owner through the Architect/Engineer and General Contractor.
- b. The Contractor will be responsible for attending all preconstruction and construction coordination meetings with the Owner and Architect/Engineer.
- c. Acceptance testing shall be conducted during normal business hours. Special testing hours must be approved in writing by Architect/Engineer and Owner.
- d. New systems and devices shall be put into service as soon as they are functional. Once put into service, they shall not be removed from service without the Owner's written authorization.
- e. Excessive assistance provided by the Architect to the Contractor, at the Contractor's request, shall be at cost to the Contractor, via back charge, equal to the Architect's cost for those personnel for the time required. All such assistance shall be subject to the prior, written approval from the Architect and shall not constitute or imply direction or approval to the Contractor on behalf of the Architect.

11. WARRANTY

- a. Warranty Period
 - i. The Contractor shall warranty all materials and workmanship during the installation period and for a period of two years, beginning with the date of final acceptance by the Owner and Architect/Engineer. The Contractor shall be responsible during the design, installation, testing and warranty periods for any damage caused by him or his subcontractors or by defects in his or his subcontractors' work, materials or equipment.
 - ii. During the warranty period, the Contractor shall inspect and test all automatic sprinkler and standpipe systems in conformance with NFPA 20. All devices shall be tested at a minimum interval of 6 months apart, with a written report submitted to Owner after each test.
- b. The Contractor shall provide emergency repair service for the systems, at no cost to the Owner, within two hours of a request for such service by the Owner during both the installation and the warranty periods. This service shall be provided on a 24 hour per day, seven days per week basis.

12. TRAINING

- a. At a time mutually agreed upon, provide 4 hours of instruction to the Owner's designated personnel on the operation and maintenance of the automatic sprinkler system and associated equipment. Owner's operation and maintenance manual prepared for this project shall be used during the instruction.
- b. The Contractor shall submit a proposed training agenda for the Architect/Engineer and Owner review and approval within 60 days of authorization to proceed. The proposed training agenda shall include, but not be limited to, the following:
 - i. Overview of system operation.
 - ii. Overview of system equipment and device locations.
 - iii. Detailed operation guidelines.
 - iv. Detailed maintenance procedures.
 - v. Periodic testing procedures.
 - vi. The Contractor shall submit the final approved training agenda 14 days prior to the first training session

B. PRODUCTS

1. PUMP

- a. Contractor shall furnish and install a Fire Pump system– UL®- listed single stage, close-coupled Vertical In-Line Pump for fire suppression. The pump(s) shall conform to the standards of NFPA 20 latest edition for the installation of centrifugal fire pumps.
- b. The pump will provide a rated capacity of as required by the design. At 150 percent of rated capacity, the pump shall develop at least 65 percent of its rated head and shall not exceed 140 percent of the rated head at zero capacity. The pump shall be tested at the factory and a test curve shall be submitted showing the performance and horsepower requirements based on this test before final acceptance.

- c. The pump shall be a single-stage, close-coupled, vertical in-line design, in cast iron bronze fitted construction with packing bearing directly on a stainless steel or a bronze shaft sleeve. The pump internals shall be capable of being serviced without disturbing piping connections.
- d. The pump casing shall be made of cast iron ASTM A278, Class 30 or 35, or ductile iron ASTM A536, Grade 65, with the suction and discharge flanges located on a common centerline, 180 degrees apart, for mounting in the pipeline. The standard pipe flanges shall be drilled for 125# per ANSI B16.1 standard.
- e. The pump shall be rated for a minimum of 175 psi working pressure and a maximum of 370 psi with 250# discharge flanges and ductile iron casing. 5. The impeller will be of a cast bronze ASTM B584 – Alloy 875, enclosed type, balanced, keyed to the shaft and secured by a cap screw and lockwasher.
- f. The casing wear rings shall be made of bronze and can be easily replaced.
- g. The pump shall be direct coupled to the motor shaft for easy maintenance, to minimize impeller run out and reduce noise.
- h. The pump shall have a vertical back pullout design that makes servicing simple and fast. The rotating element is easily removed without disturbing the piping.
- i. The pump shall have split bronze packing glands for easy packing replacement.
- j. The stuffing box shall be furnished with impregnated yarn packing, lantern ring and a catch basin for piping leakage to drain.
- k. The pump shall have gauge tappings at the suction and discharge nozzles and vent and drain tappings at the top and bottom.
- l. A rubber slinger will be installed on the shaft before the motor to prevent the passage of liquid to the motor.
- m. Nameplates and other data plates shall be all corrosion resistant and suitably secured to the pump.
- n. Pump manufacturer shall be ISO 9001 certified
- o. The pump shall be furnished with the following:
 - i. 3-1/2" dial suction and discharge gauges.
 - ii. 3/4" casing relief valve.
 - iii. Eccentric suction reducer
 - iv. Concentric discharge increaser
 - v. Hose valve test header with hose valve with 2 1/2" NST caps and chains for the above hose valves. Header and quantity of valves shall be sized for full flow of fire pump.
 - vi. Main relief valve.
 - vii. Flowmeter.
 - viii. Suction control valve

2. PRESSURE-MAINTENANCE PUMPS

- a. Pressure-Maintenance Pumps, General: Factory-assembled and -tested pumps with electric motor driver, controller, and accessories and specialties. Include cast-iron or

stainless-steel casing and bronze or stainless-steel impellers, mechanical seals, and suction and discharge flanges machined to ASME B16.1, Class 125 dimensions unless Class 250 flanges are indicated and except that connections may be threaded in sizes where flanges are not available.

- i. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
- ii. Nameplate: Complete with capacity, characteristics, and other pertinent data.
- b. Multistage, Pressure-Maintenance Pumps: Multiple-impeller type complying with requirements for multistage centrifugal pumps. Include base. Driver: NEMA MG 1, open-drip-proof, squirrel-cage, induction motor complying with NFPA 20 and NFPA 70. Include wiring compatible with controller used.
- c. Controllers: UL 508; factory-assembled, -wired, and -tested, across-the-line type for combined automatic and manual operation.
 - i. Enclosure: UL 508 and NEMA 250, Type 2, wall-mounting type for field electrical wiring.
 - ii. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.
 - iii. Rate controller for scheduled horsepower and include the following:
 1. Fusible disconnect switch.
 2. Pressure switch.
 3. Hand-off-auto selector switch.
 4. Pilot light.
 5. Running period timer.
- d. Accessories and Specialties: Match pressure-maintenance-pump suction and discharge ratings as required for pump capacity rating. Include the following:
 - i. Circulation relief valve.
 - ii. Suction and discharge pressure gages.

3 FIRE PUMP CONTROLLER:

- a. The main fire pump controller shall be a factory assembled, wired and tested and shall conform to all the requirements of the latest edition of NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection and NFPA 70, National Electrical Code. The controller shall be listed by Underwriters Laboratories, Inc., in accordance with UL218, Standard for Fire Pump Controllers and approved by Factory Mutual for fire pump service.
- b. The controller shall be of the combined manual and automatic type designed for Solid State Soft Starting of the fire pump motor having the horsepower, voltage, phase and frequency rating shown on the plans and drawings. The controller components shall be housed in a NEMA Type 2 (IEC IP11) drip-proof, wall mounted enclosure.
- c. Withstand Ratings (Short Circuit Current Ratings): All controller components shall be front mounted, wired and front accessible for maintenance. The minimum withstand rating of the controllers shall not be less than 100,000 Amps RMS Symmetrical at

200-600 Volts*. If the available system fault current exceeds these ratings, the controllers shall be supplied with a withstand rating of 150,000 or 200,000 Amps RMS Symmetrical, as required.

- d. Isolation Switch and Circuit Breaker:
 - i. The controller shall include a motor rated combination isolating disconnect switch/circuit breaker, mechanically interlocked and operated with a single, externally mounted handle. When moving the handle from OFF to ON, the interlocking mechanism shall sequence the isolating disconnect switch ON first, and then the circuit breaker. When the handle is moved from ON to OFF, the interlocking mechanism shall sequence the circuit breaker OFF first, and then the isolating disconnect switch. The isolating disconnect switch/circuit breaker shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism. The isolating disconnect switch/circuit breaker shall be capable of being padlocked in the OFF position for installation and maintenance safety, and shall also be capable of being locked in the ON position without affecting the tripping characteristics of the circuit breaker. The controller door shall have a locking type handle and three-point cam and roller vault type hardware. The circuit breaker trip curve adjustment shall be factory set, tested and sealed for the full load amps of the connected motor. The circuit breaker shall be capable of being field tested to verify actual pick up, locked rotor, and instantaneous trip points after field installation without disturbing incoming line and load conductors.
 - ii. Circuit breaker inside the controller shall be listed for fire pump application and complied with NEC 695.4(B)(2)(a). Where the fire pump lock rotor is not available, breaker setting shall be on NEC 430.251(B) rating for nominal nameplate rating of fire pipe horsepower rating.
- e. Interface: The fire pump controller shall feature an operator interface with user keypad. The interface shall monitor and display motor operating conditions, including all alarms, events, and pressure conditions. All alarms, events, and pressure conditions shall be displayed with a time and date stamp. The display shall be a 2-line, 20-character, vacuum fluorescent, dot matrix type designed to allow easy viewing from all angles and in all light conditions. The display and interface shall be NEMA rated for Type 3R protection and shall be fully accessible without opening the controller door. The display and user interface shall utilize multiple levels of password protection for system security. A minimum of 3 password levels shall be provided. The display shall be capable of being programmed for any language.
- f. Ammeter/Voltmeter: The fire pump controller operator interface shall be capable of displaying true RMS digital motor voltage and current measurements for all three phases simultaneously. Displays requiring push-button and selector switches to toggle between phases or current and voltage shall not be accepted. Voltage and current shall be measured by True RMS technology to provide the most accurate measurement for

all sine waves, including nonsinusoidal waveforms. Average responding meters will not be accepted.

- g. Digital Status/Alarm Messages: The digital display shall indicate text messages for the status and alarm conditions of:

- Motor On
- Sequential Start Time
- Minimum Run Time
- Local Start / Off Delay Time
- Remote Start
- Fail to Start
- System Battery Low
- Under Voltage
- Over Voltage
- Locked Rotor Trip
- Low Suction Pressure
- Over Frequency
- Emergency Start
- Drive Not Installed
- Motor Overload
- Pressure Error

The Sequential Start Timer and Minimum Run Timer/ Off Delay Timer shall be displayed as numeric values reflecting the value of the remaining time.

- h. LED Visual Indicators: LED indicators, visible with the door closed, shall indicate:

- Power On
- Emergency Isolating Switch Open
- Pump Running
- Low System Pressure
- Alarm
- Phase Failure
- Phase Reversal
- Interlock On

In addition to the standard alarm contacts required by NFPA20, the digital display module shall have N.O. and N.C. contacts for remote indications of any digitally displayed alarm and N.O. and N.C. contacts for remote indication up to eight, specified, programmable alarms

- i. Solid State Pressure Transducer: The controller shall be supplied with a solid state pressure transducer with a range of 0-300 psi (0-20.7 bar) ± 1 psi. The solid state pressure switch shall be used for both display of the system pressure and control of the fire pump controller. Systems using analog pressure devices or mercury switches for operational control will not be accepted
- j. The START, STOP and SYSTEM PRESSURE shall be digitally displayed and adjustable through the user interface. The pressure transducer shall be mounted inside the controller to prevent accidental damage. The pressure transducer shall be directly pipe mounted to a bulkhead pipe coupling without any other supporting members. Field connections shall be made externally at the controller coupling to prevent distortion of the pressure switch element and mechanism.
- k. Operation: A digitally set On Delay (Sequential Start) timer shall be provided as standard. Upon a call to start, the user interface shall display a message indicating the remaining time value of the On Delay timer.
- l. The controller shall be field programmable for manual stop automatic stop. If set for automatic stop-ping, the controller shall allow the user to select either a Minimum Run Timer or an Off Delay Timer. Both timers shall be programmable through the user interface

- m. The controller shall be fully programmable to allow up to 8 custom alarm messages to be displayed on the user interface S. A nonadjustable restart delay timer shall be provided to allow the residual voltage of the motor to decay prior to restarting the motor. At least 2 seconds, but no more than 3 seconds, shall elapse between stopping and restarting the pump motor
- n. A weekly test timer shall be provided as standard. The controller shall have the ability to program the time, date, and frequency of the weekly test. In addition, the controller shall have the capability to display a preventative maintenance message for a service inspection. The message text and frequency of occurrence shall be programmable through the user interface U. A Lamp Test feature shall be included. The user interface shall also have the ability to display the status of the system inputs and outputs V. The controller shall not start the fire pump motor under a single-phase condition. If the motor is already running when a phase loss occurs, the controller shall continue to run the motor, but still display a Phase Failure alarm.
- o. Provide surge protection internal or external to fire pump controller. Provide surge protection internal or external to fire pump controller. Surge suppression shall have the following minimum characteristics:
 - i. L-L, L-N, L-G protection with min. of 120 kA rating.
 - ii. With surge counter.
 - iii. With disconnect means

C. EXECUTION

1. EXAMINATION

- a. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of fire pumps.
- b. Examine roughing-in for fire-suppression piping to verify actual locations of piping connections before fire-pump installation.
- c. Proceed with installation only after unsatisfactory conditions have been corrected.

2. CONCRETE BASES

- a. Install concrete bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 15 Section "Basic Mechanical Materials and Methods."
 - i. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
 - ii. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - iii. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - iv. Install anchor bolts to elevations required for proper attachment to supported equipment.
- b. Cast-in-place concrete materials and placement requirements are specified in Division 1

3. INSTALLATION

- a. Install and align fire pump, pressure-maintenance pump, and controller according to NFPA 20.
- b. Install pumps and controllers to provide access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
- c. Set base-mounting-type pumps on concrete bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 - i. Support pump baseplate on rectangular metal blocks and shims or on metal wedges having small taper, at points near anchor bolts, to provide 3/4- to 1-1/2-inch gap between pump base and concrete base for grouting.
 - ii. Adjust metal supports or wedges until pump and driver shafts are level. Verify that coupling faces and pump suction and discharge flanges are level and plumb.
- c. Install suction and discharge piping equal to or greater than diameter of fire-pump nozzles.
- d. Install valves that are same size as piping connecting fire pumps, bypasses, test headers, and other piping systems.
- e. Install pressure gages on fire-pump suction and discharge at pressure-gage tappings.
- f. Support pumps and piping separately so weight of piping does not rest on pumps.
- g. Install piping accessories, hangers and supports, anchors, valves, meters and gages, and equipment supports.
- h. Install flow meters and sensors where indicated. Install flow meter-system components and make connections according to manufacturer's written instructions.
- i. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

4. ALIGNMENT

- a. Align split-case fire-pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- b. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- c. Align piping connections.
- d. Align pump and driver shafts for angular and parallel alignment according to tolerances specified by manufacturer.
- e. Align vertically mounted, split-case pump and driver shafts after complete unit has been made plumb on concrete base, grout has set, and anchor bolts have been tightened.

5. CONNECTIONS

- a. Install piping adjacent to pumps and equipment to allow service and maintenance.

- b. Connect water supply and discharge piping to fire pumps. Connect water supply and discharge piping to pressure-maintenance pumps.
 - c. Connect relief-valve discharge to point of disposal.
 - d. Connect controllers to pumps.
 - e. Ground equipment according to Grounding and Bonding requirements.
 - f. Connect wiring according to Conductors and Cables requirements.
6. FIELD QUALITY CONTROL
- a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in all field testing. Report results in writing.
 - b. Perform field tests for each fire pump when installation is complete. Comply with operating instructions and procedures in NFPA 20 to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as indicated, and then retest to demonstrate compliance. Verify that each fire pump performs as indicated.
 - c. Perform the following field tests and inspections and prepare test reports:
 - i. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - ii. Final Checks before Startup: Perform the following preventive-maintenance operations and checks:
 - 1. Lubricate oil-lubrication-type bearings.
 - 2. Remove grease-lubrication-type bearing covers, flush Bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - 3. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
 - 4. Verify that pump is free to rotate by hand. If pump is bound or if it drags even slightly, do not operate until cause of trouble is determined and corrected.
 - d. Starting procedure for pumps is as follows:
 - i. Prime pump by opening suction valve and closing drains, and prepare pump for operation.
 - ii. Open sealing-liquid supply valves if pump is so fitted.
 - iii. Start motor.
 - iv. Open discharge valve slowly.
 - v. Observe leakage from stuffing boxes and adjust sealing-liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland

immediately, but let packing run in before reducing leakage through stuffing boxes.

- vi. Check general mechanical operation of pump and motor. 4

- e. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- f. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Fire hoses are for field-acceptance tests only and are not property of Owner.

END OF SECTION 213000

220500	GENERAL (PLUMBING) PROVISIONS
220513	ELECTRICAL WORK IN PLUMBING CONTRACT
220523	VALVES
220529	PIPE HANGERS AND SUPPORTS
220700	INSULATION
220800	PLUMBING COMMISIONING REQUIREMENTS
221000	PIPE AND PIPE FITTINGS
221119	PIPING SPECIALTIES
224000	PLUMBING FIXTURES



A. GENERAL

1. Scope of Work
 - a. The Contractor shall provide all materials, equipment and labor necessary to install and set into operation a complete plumbing system as shown on the engineering drawings and as specified herein.
2. Quality Assurance
 - a. See the General and Supplementary General Conditions.
 - b. All work shall be in accordance with State Code and Underwriter's Regulations. Minimum requirements shall be the State Plumbing Code.
 - c. Wherever the words "Approved", "Approval", or "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
 - d. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
 - e. All material and equipment that the Contractor proposes to substitute in lieu of those specified shall be submitted to the Engineer ten (10) days before the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Items that are submitted for approval after this date will not be accepted. Section 01600 of the General Conditions will be followed for substitutions after award of the contract.
3. Submittals
 - a. See General and Supplementary General Conditions.
 - b. Within twenty days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval
 - c. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number, and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitutions for specified items. Acceptance for approval shall be in writing from the Engineer.

- d. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent upon receipt of these as-built plans.
 - e. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions as outlined in Paragraph C, (Execution), Item #6, of this specification section.
 - f. The Contractor shall submit to the Owner all certificates required for operating the system in compliance with the plans and specifications.
4. Product Delivery, Storage and Handling
- a. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
 - b. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
 - c. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
5. Work Conditions and Coordination
- a. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. A licensed electrician shall perform all electrical work.
 - b. Electrical work shall be in accordance with State codes, and as specified in Division 16 contained herein.
 - c. Pipe chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.
 - d. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.
6. Guarantee
- a. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturers warranty period.
 - b. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following the finals acceptance of the work an shall replace such defective materials or workmanship without cost to the owner.

- c. Additionally, the contractor shall guarantee materials and workmanship against latent defects arising from faulty materials, faulty workmanship or negligence which is hidden or not readily apparent to the owner at the time of final acceptance and which is discovered by the owner within six (6) years following final acceptance of the work. The contractor shall replace such defective materials or workmanship without cost to the owner.

B. PRODUCT

1. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.
2. The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core. Nameplates shall be fastened with pan head tapping screws.

C. EXECUTION

1. Inspection
 - a. This Contractor shall examine the areas of completed work and shall insure that no defects or errors are present which would result in the poor application or installation of subsequent work.
2. Installation
 - a. All work shall be performed in a manner indicating proficiency in the trade.
 - b. All pipes shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
 - c. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
 - d. All finishing shall be by the General Contractor.
 - e. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all pipes required to support his equipment.
 - f. All fixtures shall be accurately roughed in according to the manufacturer's installation dimensions so that no offset adaptors, flexible connections or other improvising are necessary. All incorrect work shall be torn out and corrected and walls and floors patched.

- g. Connections to cold water, soil and waste lines shall be made at locations shown on the Drawings.
- 3. Performance
 - a. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.
 - b. Rock excavation shall be defined in the Supplementary General Conditions. Unless specifically stated, neither rock excavation nor a unit price for rock excavation shall be required in the bid.
- 4. Erection
 - a. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.
- 5. Adjust and Clean
 - a. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
 - b. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall nameplates be painted.
 - c. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract.
- 6. Maintenance and Operating Manual
 - a. The Contractor shall prepare four (4) copies of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - 1) Index and page numbers.
 - 2) Certificate of substantial completion.
 - 3) A summary sheet of warranties with the dates noted and a copy of all warranties.
 - 4) List of all subcontractors and suppliers with names, addresses and phone numbers.
 - 5) Certified testing and balancing report.
 - 6) All submittal data and shop drawings.
 - b. The O & M manuals shall be installed in 3 ring heavy back note books with the name of the building and the words, "Operations and Maintenance Manuals" permanently affixed to the cover and spine.

- c. The operating and maintenance manuals shall be submitted to the Engineer (2) weeks before the pre-final inspection, for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION

A. GENERAL

1. This Contractor shall be responsible for the entire control system and control connections to all equipment installed as part of his contract.
2. Wiring from disconnect switches, junction boxes, panelboard circuit breakers, etc. up to plumbing equipment shall be by the electrical contractor. Refer to details on plans for connections to equipment from starter/disconnects.
3. All power and control wiring shall be in conduits.
4. All electrical work shall be performed by a licensed electrician.
5. All electrical work shall be in accordance with the State Building Code and all its supplements and the latest edition of the National Electrical Code.

B. PRODUCT

1. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
2. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
3. All conductors and conduits shall be sized as noted on the plans or as required per NEC.

C. EXECUTION

1. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
2. Control wiring electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid- Tite" conduit. Connection to other equipment shall be made with rigid conduit.
3. Control wiring conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION 220513

A. GENERAL

1. Valves shall be installed where indicated or required.
2. Insofar as possible, all valves shall be by the same manufacturer.
3. All valves stored on project site shall have ports closed.
4. Valves shall serve dual functions as shut-off and balancing valves.
5. Valves shall have an adjustable set point with locking mechanism which will permit closing of the valve and reopening of the valve to the previously determined set point.

B. PRODUCT

1. Isolation/Shutoff valves up to and including 3" in line size shall be full port, forged brass ball valves with threaded ends, Watts Series FBV-1 or approved equivalent.
2. Isolation/Shutoff valves 4" and larger shall be full port, 125# class, epoxy coated cast iron, flanged ball valves suitable for potable water service, FDA approved, Watts Series G-4000-FDA or approved equivalent
3. Provide stem extensions, as necessary, to accommodate piping insulation.

C. EXECUTION

1. All flanged connections shall be gasketed.
2. In no case shall raised face flanges be bolted to flat face flanges.
3. All valve stems shall be accessible and in no case shall valve stems be installed below horizontal.
4. The Contractor shall set in service all valves to operating conditions as part of his Contract.
5. The contractor shall provide 1" diameter brass valve tags for all valves.
6. The contractor shall provide ceiling markers for ceilings above lay-in ceiling.
7. The contractor shall provide a framed valve chart.

END OF SECTION 220523

A. GENERAL

1. This Section includes all hangers and supports, etc. as may be required to provide a complete piping system.
2. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.
3. Refer to specification Section 221000 for piping.

B. PRODUCT

1. Piping shall be as stated in Piping Section(s).
2. Hangers and supports shall be as manufactured by B-Line Systems, Inc., PHD Manufacturing, Empire, or Modern Support Devices.

C. EXECUTION

1. In no case shall this Contractor be allowed to cut or reduce the specified covering to allow the application of a smaller hanger than required.
2. Hangers shall be spaced as dictated by North Carolina Plumbing Code.
3. Hangers shall be provided at each change in direction.
4. Vertical risers shall be supported at each floor, 5 feet on center, and/or at changes in direction of pipe.
5. Do not support piping from bar joist bridging and/or roof deck.

END OF SECTION 220529

A. GENERAL

1. The Contractor shall insulate hot water supply and return, and cold water piping as specified below.
2. All insulation, linings, coverings and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50, except for exposed outside piping.

B. PRODUCT

1. All hot and cold water piping (unless otherwise noted) shall be insulated with 1" thick fibrous glass materials with factory applied cover. All hot and cold water piping located in unconditioned spaces shall be insulated with 1 1/2" thick fibrous glass materials with factory applied cover. Cover shall be embossed vapor barrier, laminated with pressure sealing cap adhesive.
2. Closed cell insulation, of equal R-value may be used in lieu of fiberglass where concealed in walls. Insulation joints are to be sealed per manufacturer's recommendations. Taped joints will not be accepted. Insulation shall be finished with a fire retardant coating to attain proper fire rating.
3. All exposed piping in finished areas and equipment spaces shall have an additional layer of Kraft paper with vapor sealing tape followed by 8oz. /sq.yd. canvas cloth wrap, glued with two coats of sizing. Canvas shall be coated twice with Foster fireproof lagging to assure flame and smoke spread ratings.

C. EXECUTION

1. Insulation shall be installed in accordance with manufacturer's recommendations.
2. All exterior piping insulation above grade shall be provided with a protective aluminum jacket with a factory-applied asphalt and Kraft paper moisture barrier. Aluminum jackets shall be cross-cirmped (longitudinally corrugated) for strength. Aluminum jackets shall be not less than 0.106" thick and shall be secured with aluminum or stainless steel screw; not more than 8" apart.
3. All piping exposed outdoors shall be wrapped with electric trace before insulation is applied.
4. Any pipe covered prior to leak testing shall be exposed at contractor expense.
5. All piping shall be provided with identification in accordance with ANDI A13.1-1981 standards. Markers shall be located at each wall, floor, and ceiling penetration, and at every 25ft (10 feet in mechanical rooms). Markers shall be fully legible from floor level showing medium contained in pipe, and direction of flow. Wording on markers shall be as follows:
 - a) "Domestic Cold Water Supply".
 - b) "Domestic Hot Water Supply".
6. Provide sheet metal saddle at each hanger. Provide wood blocking at each saddle.

END OF SECTION 220700

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper functional performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Verify that the Owner's operating personnel are adequately trained.

1.2 RELATED WORK

- A. Section 23 0900 – Instrumentation and Controls for HVAC

1.3 ABBREVIATIONS AND DEFINITIONS

- A. A/E: Architect, Architect/Engineer, Engineer and/or Design-Builder
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E. CxA: Commissioning Authority
- F. CC: Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning
- I. Cx Plan: Commissioning Plan

- J. DDC: Direct Digital Control System
- K. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- L. FT: Functional Performance Test
- M. MC: Mechanical Contractor
- N. O&M: Operation and Maintenance
- O. OPM: Owner Project Manager
- P. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- Q. PC: Prefunctional Checklist
- R. Sub(s): Subcontractors or Prime Contractor
- S. TAB: Test, Adjust and Balance

1.4 PLUMBING EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Plumbing Systems
 - 1. Hot water heating system, heater and recirculation pump
 - 2. Compressed air system
 - 3. Domestic water meter
 - 4. Interface with Building Automation System

1.5 SUBMITTALS

- A. Provide the CxA a copy of the following items, for the systems to be commissioned:
 - 1. Equipment and System Submittals to include, at minimum, the following:
 - a. Equipment Data Sheets
 - b. Performance data
 - c. Manufacturer's pre-startup checklists

- d. Manufacturer's start-up checklists
- e. Installation Instructions
2. Shop drawings (including any resubmittals required by the A/E)
3. Piping - Supply one copy of all hydrostatic pressure test results
4. Initial Pre-startup and start-up plan
5. Startup Testing Report
 - a. Prepare startup testing report on a per system basis, documenting the results of executed testing plan.
 - b. Copies of all completed test forms and checklists shall be provided.
 - c. List of all outstanding deficiencies and uncompleted items.
6. Operational and maintenance documentation
7. Training plan and training materials
8. As-built documentation

1.6 SEQUENCE OF OPERATIONS

- A. Not Applicable.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

2.2 Cx WEB-BASED COMMISSIONING TOOL

- A. All web-based software required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Prior to the start of construction, the mechanical and controls contractor will schedule a meeting with the commissioning authority to review the systems to be commissioned, the testing methodology, and other requirements.

3.2 START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. General

1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
2. The prefunctional performance test checklists shall be developed by the CxA.

B. Start-up and Initial Checkout Plan

1. The subcontractor responsible for providing and installing the equipment shall develop the full start-up plan by combining the prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checkout and inspection of each piece of equipment and a summary statement with a signature block at the end of the checklist.
2. The full start-up plan shall consist of:
 - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
 - b. The manufacturer's normally used field checkout sheets
 - c. Specifically, the mechanical start-up plan shall also include the contractors TAB plan.
3. The contractor submits the full startup plan to the CxA for review and approval.
4. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

C. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off

prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.

2. The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment. It is the intent that the commissioning authority will observe the tests during contractor testing. If the contractor does not inform the commissioning authority of testing, the commissioning authority may request the contractor to repeat the test.
3. The CxA will observe the physical start-up of all major systems.
4. For lower-level components of equipment, (e.g., sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
5. The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA.
6. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
7. Completed startup test report must be provided to CxA prior to functional testing.

D. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.3 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to functional testing and demonstration for equipment and system in this division. The functional testing check list shall be developed by the CxA.
- B. The general list of equipment and systems to be commissioned is found in section 1.4.
- C. Objectives and Scope

1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
2. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a specified system response. Verifying each sequence in the sequence of operation is required.
3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.

D. Development of Test Procedures

1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems related to feasibility, safety, equipment and warranty protection.

E. Coordination and Scheduling

1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

G. Demonstration, Verification and Validation

1. Hot water heating system shall be tested to ensure that hot water temperature can be maintained, recirculation system is operational.

2. Compressed air system shall be tested to ensure that BAS monitors compressor operation and line pressure.
3. Domestic water meter shall be tested for totalization.

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. In addition to Installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment.

3.6 TRAINING OF OWNER PERSONNEL

- A. CxA shall document the completion of comprehensive Owner training. Training shall include the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment or system.
- B. Training shall include classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation.

END OF SECTION

A. GENERAL

1. This section includes all pipe, pipe fittings, hangers, and supports, etc. as may be required to provide a complete water plumbing system.
2. The actual arrangement of the piping shall follow the general locations shown on the drawings, such that clearances, line drainage, etc. shall be maintained.
3. Refer to specification Section 220523 Plumbing Valves
4. Refer to specification Section 220529 Plumbing Hangers.
5. Refer to specification Section 220700 Plumbing Insulation.
6. Refer to specification Section 221119 Plumbing Piping Specialties.

B. PRODUCT

1. Domestic Water Pipe and Pipe Fittings
 - a) Copper Pipe
 1. Water piping above grade shall be Type "L" hard drawn copper. Water piping below grade shall be Type "K" soft drawn. Pipe shall conform to ASTM B-88 Specification.
 2. Water piping fittings shall be sweat or grooved type wrought copper conforming the ANSI-B16.22, ASME B16.18, or ASTM B584 Specification.
 3. Use silver solder on all piping.
 2. Storm, Sanitary Waste and Vent Pipe and Pipe Fittings
 - a) Cast Iron Pipe
 1. Building sanitary sewer and storm line below grade shall be service weight cast iron, with hub and spigot type joints, with neoprene "Charlotte" seal.
 2. Building sanitary sewer, storm, and vent lines above grade shall be cast iron with no hub joints with stainless steel bands.
 3. Cast iron fittings to conform to piping specifications.
 4. Waste pipe shall be tested at each floor. A test tee will be installed below each floor and pipe will be filled with water for a height of 10' above finished floor. The pipe shall be gas and water tight. Water shall stand in the system for a period of 3 hours without evidence of leakage.
 5. Horizontal roof drain leaders above grade shall be insulated with 1" fiberglass.
 6. Waste piping, above ceilings, from floor drains shall be insulated with 1" fiberglass.
 - b) PVC Pipe

1. Building sanitary sewer and storm lines below grade shall be schedule 40 PVC-DWV conforming to ASTM D-2665-68.
2. Building sanitary sewer, storm, and vent lines above grade shall be schedule 40 PVC-DWV conforming to ASTM D-2665-68.
3. PVC fittings to conform to piping specifications.
4. Joints for PVC piping shall be made using the piping manufacturer's approved solvent cement.
5. Waste pipe shall be tested at each floor. A test tee will be installed below each floor and pipe will be filled with water for a height of 10' above finished floor. The pipe shall be gas and water tight. Water shall stand in the system for a period of 3 hours without evidence of leakage.
6. PVC piping is not permitted in return air plenums.
7. PVC piping is not permitted for dishwasher waste. Cast iron piping is to be used.

C. EXECUTION

1. Sleeves shall be provided wherever pipes pass through walls, floors, and ceilings. Sleeves shall be Schedule 40, black steel, $\frac{1}{2}$ " in diameter larger than the pipe or insulation on the pipe. Sleeves through floors shall be caulked and made watertight.
2. In pipe chases, the Contractor shall provide for suspension of all piping from the structure. Do not allow piping to rub against masonry when expanding and contracting.
3. Close and protect open ends of piping until final connections are made. Such closing shall be made with fittings which cannot be easily removed. Caps or plugs shall be required at all times during construction so that no pipes are left open at the end of any day's work, even though continuation is expected the next day.
4. All piping and equipment installed under this Contract shall be tested in the presence of the Engineer or a designated representative of the Owner, and the proper Plumbing Inspector, proved tight for the periods stated above, or longer if required by the Inspector. Engineer shall be given 48 hour written notification of all tests.
5. No plumbing system or part thereof shall be covered or concealed until after it has been tested and approved. If such work has been covered or concealed before testing, it shall be exposed for testing.
6. All water piping shall be sterilized with chlorine, 50 milligrams per liter, and held for a 24-hour period, after which the system shall be flushed prior to being put into service. During the flushing of the system, all flush valves shall be thoroughly flushed out to insure the removal of sediment, pipe dope, etc., from water lines and flush valves, removing such working parts of the flush valves as may be deemed necessary. The system shall be

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drained and flushed sufficiently to provide chlorine residue of 0.2 ppm or less.

END OF SECTION 221000

A. GENERAL

1. This Section includes miscellaneous items required for a complete plumbing system.

B. PRODUCT

1. Escutcheons shall be chrome plated, spring type, on all pipes passing through walls and ceilings in finished areas. Floor escutcheons shall be cast brass, chrome plated, with set screw.
2. Stops shall be compression type, chrome plated, angle or straight way pattern on all fixtures, hot and cold water supply. On service sinks, use brass gate valve as specified.
3. Flashing for vents through the roof shall be two-piece type, 16 ounce copper counter flashing and base flashing, or a two-piece type, 4 pound lead counter flashing and base flashing. The base flashing shall be installed by the General Contractor with the roof system.
4. Pipe anchors for rough-in use shall be "Rapid Rough" products. Use for anchoring rough-in of all hot and cold water connections for all lavatories, sinks and other wall connected fixtures.
5. Insulating couplings shall be V-line, as manufactured by Walter Vallett or approved equal.
6. Shock absorbers shall be of all stainless steel construction and in conformance with P. D. I. Standard WH201. Shock absorbers shall be installed as noted at the locations shown on the plans and shall be totally accessible. Where there are no shock absorbers noted or shown on the plans, 18 inch air chamber type shock absorbers shall be installed at the hot and cold water supply to each fixture.
7. Unions shall be bronze body with packless brass ground joints. Wrought iron pipe unions shall be malleable iron, ground joint with bronze to iron seat.

C. EXECUTION

1. Escutcheons shall be of sufficient size to cover outside diameter of the pipe or the insulation of the pipe.
2. Vent flashing shall extend down at least 4 inches from the top of the pipe. Flashing shall extend at least 12 inches in all directions from the pipe and shall be parallel to the roof line.
3. Pipe anchors for rough-in use shall be installed to hold pipes securely in alignment, according to the manufacturer's rough-in dimensions. Remove these devices after the wall is built around the pipes.
4. Unions shall be installed as shown on the plans, and where required, to disconnect piping for future replacement or repairs.
5. Dielectric unions shall be installed at hot water heaters and at any junction of dissimilar metal pipes.

END OF SECTION 221119

A. GENERAL

1. Provide plumbing fixtures as scheduled on the drawings.
2. All fixtures shall be by one manufacturer insofar as possible.
3. Submit shop drawings on the following:
 - a. Fixtures
 - b. Floor drains and cleanouts
 - c. Trim
4. All china fixtures are to be white.
5. All faucets, shower valves, trim, escutcheons to be chrome plated unless otherwise noted on the plans

B. PRODUCT

1. Products approved for use on this shall be as follows:
 - a. Fixtures: Kohler, American Standard, Eljer, Zurn, Toto, Crane
 - b. Stainless steel sinks: Elkay, Just
 - c. Flush Valves: Sloan, Delaney, Zurn
 - d. Floor drains and cleanouts: Zurn, Smith, and Josam.
 - e. Trim: Kohler, American Standard, Eljer, Chicago Faucets, T & S Brass and Bronze, Delta, Symmons, Sloan, Delaney, Stern-Williams, McGuire, Brasscraft, Cambridge Brass, Speakman, Zurn, Moen.

C. EXECUTION

1. Fixtures and carriers shall be installed in accordance with the manufacturer's recommendations.
2. All fixtures, drains, traps, etc. shall be set plumb and level.
3. All handicapped fixtures and trim shall be installed in accordance with the State Building Code, latest edition.
4. Provide trap primer and required piping on all floor drains.
5. All fixtures are to be water saving type.
6. Provide vandal-proof options for all fixtures used by public. This includes screws, aerators, and showerheads.
7. Wiring for hard wired sensor faucets and flush valves to be run in conduit.

END OF SECTION 224000

MECHANICAL SPECIFICATIONS INDEX

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SECTION 230500 - GENERAL MECHANICAL REQUIREMENTS

A. GENERAL

1. Scope of Work
 - a. The Contractor shall provide all materials, equipment and labor necessary to install and set into operation a complete mechanical systems as shown on the engineering drawings and as specified herein.
2. Quality Assurance
 - a. See the General and Supplementary General Conditions.
 - b. All work shall be in accordance with State Code and Underwriter's Regulations. Minimum requirements shall be the State Plumbing, Mechanical, Gas, and Energy Code.
 - c. Wherever the words "Approved", "Approval", or "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
 - d. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
 - e. All material and equipment that the Contractor proposes to substitute in lieu of those specified, shall be submitted to the Engineer ten (10) days before the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Items that are submitted for approval after this date will not be accepted. The General Conditions will be followed for substitutions after award of the contract.
3. Submittals
 - a. See General and Supplementary General Conditions.
 - b. Within twenty days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit to the Architect/Engineer for approval a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval
 - c. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number, and all necessary performance and

fabrication data. Detailed submittal data shall be provided when items are to be considered as substitutions for specified items. Acceptance for approval shall be in writing from the Engineer.

- d. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent upon receipt of these as-built plans.
 - e. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions as outlined in Paragraph C, (Execution), Item #6, of this specification section.
 - f. The Contractor shall submit to the Owner all certificates required for operating the system in compliance with the plans and specifications.
4. Product Delivery, Storage and Handling
- a. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
 - b. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
 - c. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
5. Work Conditions and Coordination
- a. The Contractor shall review the electrical plans to establish points of connection and the extent of electrical work to be provided in his Contract. All electrical work shall be performed by a licensed electrician.
 - b. Electrical work shall be in accordance with State codes, and as specified in Division 16 contained herein.
 - c. Pipe chases required for installation of work shall be provided by the General Contractor unless otherwise noted. This Contractor shall be responsible for coordinating the location of all required chases.
 - d. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be at the Contractor's expense at no extra cost to the Owner.
6. Guarantee
- a. Where items of equipment or material carry a manufacturer's warranty for any period in excess of twelve (12) months, then the manufacturer's warranty shall apply for that particular piece of equipment or material. The contractor shall replace such defective equipment or materials, without cost to the owner, within the manufacturers warranty period.
 - b. The contractor shall unconditionally guarantee materials and workmanship against patent defects arising from faulty materials, faulty workmanship or negligence for a period of twelve (12) months following

the final acceptance of the work and shall replace such defective materials or workmanship without cost to the owner.

- c. The contractor shall provide a five year compressor warranty for all refrigeration compressors from date of system acceptance.
- d. Additionally, the contractor shall guarantee materials and workmanship against latent defects arising from faulty materials, faulty workmanship or negligence which is hidden or not readily apparent to the owner at the time of final acceptance and which is discovered by the owner within six (6) years following final acceptance of the work. The contractor shall replace such defective materials or workmanship without cost to the owner.

B. PRODUCT

1. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Material and equipment found defective shall be removed and replaced at the Contractor's expense.
2. The Contractor shall provide nameplates for identification of all equipment, switches, panels, etc. The nameplates shall be laminated phenolic plastic, black front and back with white core, white engraved letters (1/4" minimum) etched into the white core. Nameplates shall be fastened with pan head tapping screws.

C. EXECUTION

1. Inspection
 - a. This Contractor shall examine the areas of completed work and shall insure that no defects or errors are present which would result in the poor application or installation of subsequent work.
2. Installation
 - a. All work shall be performed in a manner indicating proficiency in the trade.
 - b. All pipes shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
 - c. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
 - d. All finishing shall be by the General Contractor.
 - e. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish all sleeves to the General Contractor for openings through poured masonry floors or walls, above grade, required for passage of all pipes required to support his equipment.
 - e. All fixtures shall be accurately roughed in according to the manufacturer's installation dimensions so that no offset adaptors, flexible

connections or other improvising are necessary. All incorrect work shall be torn out and corrected and walls and floors patched.

3. Performance
 - a. The Contractor shall perform all excavation and backfill operations necessary for installation of his work.
 - b. Rock excavation shall be defined in the Supplementary General Conditions. Unless specifically stated, neither rock excavation nor a unit price for rock excavation shall be required in the bid.
4. Erection
 - a. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.
5. Adjust and Clean
 - a. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
 - b. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for intended service. In no event shall nameplates be painted.
 - c. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract.
6. Maintenance and Operating Manual
 - a. The Contractor shall prepare four (4) copies of a manual describing the proper maintenance and system operation. This manual shall not consist of standard factory printed data intended for dimension or design purposes (although these may be included), but shall be prepared to describe this particular job. This manual shall include the following:
 - 1) Index and page numbers.
 - 2) Certificate of substantial completion.
 - 3) A summary sheet of warranties with the dates noted and a copy of all warranties.
 - 4) List of all subcontractors and suppliers with names, addresses and phone numbers.
 - 5) Certified testing and balancing report.
 - 6) All submittal data and shop drawings.
 - b. The O & M manuals shall be installed in 3 ring heavy back note books with the name of the building and the words, "Operations and Maintenance Manuals" permanently affixed to the cover and spine.

- c. The operating and maintenance manuals shall be submitted to the Engineer (2) weeks before the pre-final inspection, for approval. When the manuals are considered complete by the Engineer, they will be turned over to the Owner for their permanent use.

END OF SECTION 230500

SECTION 230513 – ELECTRICAL WORK IN MECHANICAL CONTRACT

A. GENERAL

1. This Contractor shall be responsible for the entire control system and control connections to all equipment installed as part of his contract.
2. Wiring from disconnect switches, junction boxes, etc. up to mechanical equipment shall be by this contractor. Final electrical connections to mechanical equipment shall be by this contractor.
3. All power and control wiring shall be in conduits.
4. All electrical work shall be performed by a licensed electrician.
5. All electrical work shall be in accordance with the State Building Code and all its supplements and the latest edition of the National Electrical Code.

B. PRODUCT

1. All motor starters, disconnects, switches, relays, conduits, conductors, etc. that are required for a complete electrical power and/or control system shall conform to the requirements set forth by NEC.
2. Refer to the plans for the type, size and electrical characteristics of the starters, disconnects, switches, relays, conductor and conduits.
3. All conductors and conduits shall be sized as noted on the plans or as required per NEC.

C. EXECUTION

1. All motor starters, disconnects, and switches shall be installed on or as close to the equipment they are serving as possible, or where shown on the plans.
2. Electrical connection to equipment subject to vibration which develops objectionable noises shall be made from the conduit system with short lengths of flexible "Liquid- Tite" conduit. Connection to other equipment shall be made with rigid conduit.
3. Conduits shall be run in a concealed space such as wall cavities, ceiling cavities, etc. except in the mechanical rooms where conduit may be run exposed.

END OF SECTION 230513

SECTION 230523 – VALVES

A. GENERAL

1. Valves shall be installed where indicated or required.
2. Insofar as possible, all valves shall be by the same manufacturer.
3. All valves stored on project site shall have ports closed.

B. PRODUCT

1. SIZES UP TO AND INCLUDING 2-1/2” BRONZE BODY SCREW IN

	BALL	CHECK	GLOBE	GATE
Hammond	8201	IB 946	IB 413T (2-1/2” IB 420)	IB 618
Nibco	T-580	T-433-Y	T-235-Y	T-125
Milwaukee	BA-200	510T	590	1162

2. SIZES 3” AND OVER FLANGE CONNECTED IRON BODY

	CHECK	GLOBE	BUTTERFLY	GATE
Hammond	IR 9354	IR 116	6200	IR 1140
Nibco	F-910	F-718-B	LD-3100	F-617-0
Milwaukee	1800	F-2981	M1-1228	F-2885

3. Grooved butterfly valves and check valves may be utilized on CH, HW, and CW grooved piping; Victaulic Series 761, W761, Series 716, 779, W715.
4. Manual balancing valves shall be Armstrong type CBV, Tour & Andersson or approved equivalent. Automatic balancing valves shall be Griswold, or Victaulic Series 76 with removable cartridges or approved equivalent.

C. EXECUTION

1. All flanged connections shall be gasketed.
2. In no case shall raised face flanges be bolted to flat face flanges.
3. All valve stems shall be accessible and in no case shall valve stems be installed below horizontal.
4. The Contractor shall set in service all valves to operating conditions as part of his Contract.
5. Provide valve extension handles to provide easy operation through insulation.
6. The contractor shall provide 1” diameter brass valve tags for all valves.
7. The contractor shall provide ceiling markers for ceilings above lay-in ceilings.
8. The contractor shall provide a framed valve chart.
9. Provide submittals showing gpm and pressure drop.

END OF SECTION 230523

SECTION 230529 – PIPE HANGER AND SUPPORTS

A. GENERAL

1. This Section includes all hangers and supports, etc. as may be required to provide a complete piping system.
2. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.
3. Refer to specification Section 231000 for piping.

B. PRODUCT

1. Piping shall be as stated in Piping Section(s).
2. Hangers and supports shall be as manufactured by B-Line Systems, Inc., PHD Manufacturing, Empire, or Modern Support Devices.

C. EXECUTION

1. In no case shall this Contractor be allowed to cut or reduce the specified covering to allow the application of a smaller hanger than required.
2. Hangers shall be spaced as dictated by North Carolina Plumbing Code.
3. Hangers shall be provided at each change in direction.
4. Vertical risers shall be supported at each floor, 5 feet on center, and/or at changes in direction of pipe.
5. Do not support piping from bar joist bridging and/or roof deck.

END OF SECTION 230529

SECTION 230553 – IDENTIFICATION OF HVAC COMPONENTS

A. GENERAL

1. This section includes insulation for piping, ductwork, and equipment, as shown on the plans.
2. All coverings, and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50.

B. PRODUCT

C. EXECUTION

1. EQUIPMENT

- a. All HVAC equipment, including air handlers, fans and pumps shall be properly identified with equipment identification, equipment controlled, electrical ratings and date of installation.
- b. Equipment shall be clearly identified with engraved phenolic plates securely fastened to the equipment with sheet metal screws. Phenolic plates shall be white background and black lettering.
- c. All serviceable equipment (fans, reheat coils, VAV boxes, etc.) located above ceilings or other concealed spaces shall clearly identified on an adjacent finished surface below service space. Label shall be engraved phenolic plate with white background and white letters. Label shall list name of equipment.
- d. Equipment labeling shall be coordinated with owner to match identification used by Building Automaton System.

2. DUCTWORK

- a. Paint all exposed ductwork insulation in mechanical rooms white. Ductwork exposed in finished spaces shall be painted as shown on architectural plans.

Duct System	Color Stencil Identification	Label Color	Lettering Color
Supply Ductwork	SUPPLY AIR	Green	White
Return Ductwork	RETURN AIR	Blue	White
Relief Ductwork	RELIEF AIR	Blue	White
OA Ductwork	OUTSIDE AIR	Blue	White
Exhaust Ductwork	EXHAUST	Yellow	Black

3. PIPING AND VALVES

- a. Valve Identification

- i. All valves shall be tagged brass valve tags with chains for isolation and control valves.
 - ii. Provide valve tag chart in the O&M manual.
 - iii. Provide faded valve tag chart with lexan cover mounted in each mechanical room. Chart shall include all valves in that room.
 - iv. Include the tag numbers in the as-built drawings.
- b. All piping shall be provided with identification in accordance with ANSI A13.1-1981 standards. Markers shall be located at each wall, floor or ceiling penetration, and at every 20 ft. Markets shall be fully legible from floor level showing medium contained pipe, and direction flow. Stenciling as indicated below will be acceptable in lieu of markers.
- c. All exposed piping in mechanical rooms shall be painted and marked as listed below:

Piping System	Color	Stencil Identification	Label Color	Lettering Color
Condensate Return	Gray	COND	Green	White
Chilled Water	Dark Blue	CHW	Green	White
Heating Water	Dark Orange	HHW	Green	White
Natural Gas	Yellow	GAS	Yellow	Black

- d. Pipe identification shall contrast in color to the pipe colors and be easily readable. The width of color bands should be equal to the size of the stencil indicated below.
- e. For insulated pipe systems, stencil sizes are as follows:
 - i. For pipes up to 1 inch, use 1/2 inch letters.
 - ii. For pipes 1 inch to 2 inches, use 3/4 inch letters.
 - iii. For pipes 2 inches to 4 inches, use 1 1/4 inch letters
 - iv. For pipes 4 inches to 6 inches, use 1 1/4 inch letters.
 - v. For pipes above 6 inches, use 4 inch letters.
- f. For un-insulated systems, stencil sizes are as follows:
 - i. For pipe diameters up to 1 inch, use 1/2 inch letters.
 - ii. For pipe diameters from 1 inch to 2 inches, use 1 inch letters.
 - iii. For pipe diameters from 2 inches to 6 inches, use 2 inch letters.

iv. For pipe diameters over 6 inches, use 3 inch letters.

END OF SECTION 230553

SECTION 230593 – TESTING AND BALANCING

A. GENERAL

1. SECTION INCLUDES

a. Testing, Adjusting, and Balancing:

- i. Air condition equipment, including air distribution devices, supply ducts, air handling units, condensing units, fans, coils, and related equipment.
- ii. Hydronic systems, including pumps, water distribution systems, chillers, boilers, heat exchangers, coils, and related equipment.

2. REFERENCES

- a. American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE)
 - i. Standard 111-2008 – Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-conditioning and Refrigeration Systems.
 - ii. Applications Handbook 2019, Chapter 39 – Testing, Adjusting, and Balancing
- b. Testing, Adjusting and Balancing Bureau (TABB) – International Standards for Environmental Systems Balance.
- c. Sheet Metal and Air Conditioning Contractors’ National Standards for Total System Balance.
- d. Associated Air Balance Council (AABC) – National Standards for Total System Balance.
- e. National Environmental Balancing Bureau (NEBB) – Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

3. DEFINITIONS

- a. Adjusting: Varying of system flow by modifying settings of dampers and valves, in combination with varying fan speeds to obtain optimum operating conditions for the entire system.
- b. Balancing: Proportioning of air and hydronic flows through system mains, branches and terminal devices using standardized procedures to obtain specified air or hydronic flow while imposing the least amount of restriction on the HVAC system.
- c. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, air and hydronic flow in velocities or quantities used in evaluating the performance of an HVAC system.

4. COORDINATION

- a. The testing, adjusting and balancing Contractor shall coordinate his work with the mechanical system and temperature control system installing Contractors to accomplish coordination and verification of system operation and readiness for testing, adjusting and balancing.

- b. Coordinate and assist CxP with all verification activities including providing all required sampling data necessary for the commissioning process.

5. SUBMITTALS

a. Qualification Statements:

- i. Submit company's certification documents, including:
- ii. Contractor Certification:
- iii. Supervisor Certification
- iv. Technician Certification
- v. Submit name of testing agency to Owner within thirty (30) days on Notice to Proceed.
- vi. Submit list of projects completed by testing agency of similar size, scope and equipment. Include name of Contractor and building Owner contacts.
- vii. Submit a certification letter stating that the TAB agency is an independent entity not owned in part or in whole by any subcontractor employed on the current project.

b. Reports:

- i. Deficiency Report: Following examination of installed system, prior to balancing, submit report indicating system deficiencies that would prevent proper testing, adjusting and balancing of systems and equipment to meet specified performance.
- ii. TAB Report: Submit a copy of the complete testing, adjusting and balancing report to FMC Project Manager and RECS Atlanta Staff Engineer via email when it becomes available. Report shall include any drawings indicating air outlets, thermostats and equipment identified to correspond with data sheets.
- iii. Reports shall be on TABB/SMACNA (NEBB or AABC), forms that indicate information addressing each of the testing methods, readings and adjustments.

c. Closeout Submittals:

- i. Provide complete copy of testing, adjusting and balancing report. Include report in operation and maintenance manual.

6. QUALITY ASSURANCE

a. Qualifications:

- i. Testing and balancing shall be performed by a testing agency who specializes in testing, adjusting and balancing of heating, ventilating, air-moving equipment, air-conditioning systems and hydronic systems, and has a minimum of one (1) year experience.
- ii. Testing agency shall have successfully completed a minimum of five (5) projects, similar in size and scope.
- iii. Testing agency shall be a certified member of TABB (AABC and/or NEBB).

- iv. Maintain a copy of applicable standards at the project site.
- b. Certifications:
 - i. TAB Technician shall be certified by a nationally recognized certifying agency (AABC and/or NEBB).
 - ii. Perform total system balance in accordance with Testing, Adjusting and Balancing Bureau (TABBB) – Quality Assurance Program for Environmental Systems Balance, and (AABC National Standards for Field Measurement and Instrumentation and/or NEBB Quality Assurance Program – Conformance Certification).
- c. PROJECT CONDITIONS
 - i. Testing, adjusting and balancing shall commence after the HVAC systems installation is complete and in working order. Associated areas of general construction shall be in place including interior and exterior doors, windows, walls, ceilings and existing conditions.
- d. SPECIAL WARRANTY
 - i. Provide warranty for period of ninety (90) days following physical occupancy of building, during which time the Owner may request a re-check of up to 10% of total number of terminals, or resetting of any outlet, coil or device listed in the test report. This period of time shall be no longer than 180 days after submission of the completed report.
 - ii. Warranty shall meet the requirements of the following program(s):
 - 1. TABBB – Quality Assurance Program
 - 2. AABC – National Performance Guarantee
 - 3. NEBB – Conformance Certification

B. PRODUCTS – NOT USED

C. EXECUTION

- 1. Prior to commencing testing, adjusting and balancing of environmental system(s), verify the following conditions; if deficiencies are evident, submit Deficiency Report to Engineer. Do not begin testing, adjusting and balancing of environmental system until deficiencies have been remedied.
 - a. Systems are started and operating in a safe and normal condition.
 - b. Temperature control systems are installed, complete, and operable.
 - c. Automatic and manual dampers are operable and fully open.
 - d. Thermal overload protection is in place for fans, pumps, chillers and other equipment.
 - e. Start up air filters are removed.
 - f. Final filters are clean and properly installed.
 - g. Duct and fan systems are clean.
 - h. Fans are rotating correctly.
 - i. Fire and volume dampers are in place and open.
 - j. Air coils fins are cleaned and combed.

- k. Access doors are closed and duct end caps are in place.
 - l. Air outlets are installed and connected.
 - m. Hydronic systems are pressure tested, flushed, filled and properly vented.
 - n. Leak testing on duct system has been performed in accordance with SMACNA Standards, or as specified.
 - o. Pumps are rotating correctly.
 - p. (Start-up/construction) strainers have been removed and all permanent strainers are clean and in place.
 - q. Gauges and/or test parts are properly located for balancing.
 - r. Service and balance valves are fully open.
2. SITE TOLERANCES
- a. Air Handling Systems: Adjust to within plus 10 percent of outlet total plus allowable leakage rate.
 - b. Air Outlets and Inlets: Adjust to within plus or minus 10 percent of design for the space.
 - c. Hydronic Systems: Adjust to within plus or minus 10 percent of design flow.
 - d. Hydronic Terminal Devices: Adjust to within plus or minus 10 percent of design flow.
3. AIR SYSTEMS PROCEDURE
- a. Adhere to the following procedure:
 - i. TABB – HVAC Testing, Adjusting and Balancing International Standards; with particular focus on the following chapters:
 - ii. Preliminary TABB procedures
 - iii. General air systems TABB procedures
 - b. TABB procedures for specific (VAV, CAV, Multizone, Dual duct, etc.) air systems
 - c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) HVAC Systems – Testing, Adjusting and Balancing.
 - d. NEBB – Procedural standards for TAB of environmental systems.
 - e. AABC – National standards for total systems balance.
 - f. Minimum air procedures should include the following:
 - i. Test and adjust fan RPM to design requirements.
 - ii. Test and record motor full load nameplate rating and actual ampere draw.
 - iii. Test and record system static pressures, fan suction and discharge.
 - iv. Adjust all main supply and return air duct to within tolerances listed in this section of work

- v. Test and adjust each diffuser, grille and register. Reading and tests of diffusers, grilles and registers shall include design velocity (FPM) and adjusted velocity, design CFM and adjusted CFM.
- vi. Test and record outside, mixed air, and discharge temperatures (D.B. for heating cycle, D.B. and W.B. for cooling cycle).
- vii. In coordination with the ATC contractor, set adjustments of automatically operated dampers to operate as specified, indicated and/or noted.
- viii. Test and adjust air handling and distribution systems to provide required or design supply, return, outside and exhaust air quantities within design tolerance
- ix. In air systems employing filters, blank off filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- x. Make air velocity measurements in ducts by Pitot tube traverse entire cross-sectional area of duct in accordance with SMACNA equal area method or Log Linear method.
- xi. Measure air quantities at all air inlets and outlets.
- xii. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels.
- xiii. Vary total system air quantities by adjustments of fan speeds. Provide drive changes recommendations. Vary branch air quantities by damper regulation.
- xiv. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for loading of filters and coils.
- xv. Adjust outside air automatic dampers. Outside air, return air and exhaust dampers for design conditions within specified tolerances.
- xvi. Where modulating dampers or economizers are provided, take and record measurement at full return air, minimum outside air and 100 percent outside air mode of operation.
- xvii. Verify and record, in the T&B Report, “K” factors for all VAV air terminal devices and air flow stations.

4. HYDRONIC SYSTEM PRESSURE

- a. Adhere to the following procedure:
 - i. Testing, Adjusting and Balancing Bureau (TABBB) – International Standards for Environmental Systems Balance
 - ii. SMACNA – HVAC Testing, Adjusting and Balancing International Standards; with particular focus on the following chapter:
 - 1. Hydronic TAB procedures
 - 2. NEBB – Procedural standards for TAB of environmental systems.
 - 3. AABC – National standards for total systems balance.

- b. Hydronic balancing shall include the following minimum data:
 - i. Prepare itemized equipment schedules, listing all heating and/or cooling elements and equipment in the systems to be balanced. List, in order on equipment schedules, by pump or zone according to the design, all heating and/or cooling elements, all zone balancing valves, and circuit pumps, ending with the last items of equipment or transfer element in the respective zone or circuit. Include on schedule sheet column titles listing the location, type of element or apparatus, design conditions and measured conditions. Prepare individual pump report sheets for each zone or circuit.
 - ii. Use calibrated Venturi tubes, orifices, metered fittings, pressure gages and direct reading instrumentation to determine flow rates for system balance. Where flow-metering devices are not installed, flow balance in temperature difference across various heat transfer elements in the system is acceptable.
 - iii. 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.
 - iv. Adjust hydronic 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.
 - v. Test pumps and adjust flow. Record the following on pump report sheets:
 - 1. Suction and discharge pressure;
 - 2. Running amps and brake horsepower of pump motor under full flow and no flow conditions;
 - 3. Pressure drop across pump in feet of water and total GMP pump is handling under full flow conditions.
 - vi. Where available pump capacity is less than total flow requirements or individual system parts, proportional balancing must be performed.

5. ADJUSTING

- a. Recorded data shall represent actual measured or observed conditions.
- b. Permanently mark setting of valves, dampers and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- c. Leave systems in proper working, replacing belt guards, closing access doors, closing doors to electrical switch boxes and restoring thermostats to specified settings.
- d. Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.

END OF SECTION 230593

SECTION 230600 – INITIAL SYSTEM CLEANING

A. GENERAL

1. Provide chemical solution for system clean-up.
2. Chemical product shall be by Dearborn or approved equal by Incor.

B. PRODUCT

1. Provide a pre-mix Dearborn Aqua-Serv BC-45 cleaner for chemical pre-cleaning of all hydronic systems prior to start-up.
2. Quantity of chemicals required shall be as recommended by the chemical product manufacturer.
3. Provide a chemical rust inhibitor, such as Calgon CS or approved equal, for a permanent addition to the system.

C. EXECUTION

1. Prior to system start-up, all piping and equipment shall be cleaned with a chemical cleaner to remove oil, grease, mill scale and other foreign materials.
2. Mechanical Contractor shall be responsible for all cleaning and flushing operations.
3. The chemical cleaner shall be added to the system during the system fill-up stage in a dosage recommended by the product manufacturer, and circulated within the system for 48 hours.
4. While flushing/cleaning hydronic piping systems, ensure that fluid velocity is at least 4 FPA to completely remove piping system containments.
5. After the system is thoroughly cleaned, drain the system and fill with fresh water and flush thoroughly. Remove and clean all system strainers.
6. Refill system with fresh water and add a permanent rust inhibitor such as Calgon CS in a quantity recommended by the manufacturer.

END OF SECTION 230600

SECTION 230700 – INSULATION

A. GENERAL

1. This section includes insulation for piping, ductwork, and equipment, as shown on the plans.
2. All insulation, linings, coverings, and adhesives shall have a flame spread classification of 25 or less and a smoke developed rating of not more than 50.
3. Insulation shall be Certainteed, Owens Corning, or Johns-Manville.

B. PRODUCT

1. Duct
 - a) Unless otherwise noted in the drawings all rectangular and round air conditioning supply, return, exhaust, and outside air duct shall be externally insulated with 3” thick, 3/4 lb. density foil scrim Kraft jacketed insulation. Joints shall be wrapped with a minimum of 3” wide FSK band of insulation to prevent any possible leakage and condensation. Ducts with widths over 30” shall be further secured on the underside with mechanical fasteners on 18” maximum centers.
 - b) In addition to the duct wrap specified in B1.a of this specification, all low pressure rectangular supply and return ductwork shall be lined for 15 feet downstream from air handling unit (or up to and including the first 90 degree elbow). Duct liner shall be 1” thick, 2lb. dense, Shuller Permorate Linacoustic HP, or approved equivalent. Coat all exposed leading edges and transverse joints with a fire retardant adhesive.
 - c) Duct sizes shown are actual duct dimension. Where ductwork is lined, as noted above, the duct insulation thickness shall be added to the listed ductwork dimensions for final duct size.
 - d) Duct routed outside the building shall be insulated with minimum R-8 fiberglass. All joints shall be sealed with mastic prior to insulating. Apply final skin of sheet metal and seal weather tight.
 - e) Ductwork located in mechanical rooms shall be wrapped with duct board insulation 2” thickness rigid Fiberglas Owens/Corning or equal, ASTM C 612, 3 pounds per cubic foot density, with Foil reinforced jacket. The board shall be attached with field applied perforated base pins or weld pins applied on 12” centers. Finish shall be 8oz canvas jacket, totally sized with Foster 81-42W or equal lagging adhesive. Corner board shall be used on all edges.
 - f) Ductwork located outside the building shall be wrapped with duct board insulation 2” thickness rigid Fiberglas Owens/Corning or equal, ASTM C 612, 3 pounds per cubic foot density, with Foil reinforced jacket. The board shall be attached with field applied perforated base pins or weld pins applied on 12” centers. Board shall be wrapped with self-adhesive weather barrier equal to Alumaguard.

2. Piping

- a) All heating hot water supply and return piping, fittings, valves, elbows etc., above grade shall be insulated with 4 lb. density snap-on type glass fiber pipe insulation in molded sections with factory applied all service jacket. Seams shall be closely buttoned together and secured by self-sealing or pasting the all service lap. Fittings insulation shall be milled pre-fabricated of same material and thickness as on adjacent pipe. Exposed fittings shall be finished with 8 oz. canvas jacket neatly pasted in place or factory pre-formed PVC jacket covers. Piping 2" or less shall have 1" thick insulation. Piping larger than 2" shall have 2" thick insulation. Piping exposed in occupied spaces and mechanical equipment rooms shall have canvas lagged in place for painting.
- b) All chilled water supply and return piping, fittings, valves elbows, etc., above grade shall be insulated with polyisocyanurate insulation in molded sections with factory applied all service jacket. Seams shall be closed butted together and secured by self-sealing or pasting the all service lap. Fittings insulation shall be milled pre-fabricated of same material and thickness as on adjacent pipe. Exposed fittings shall be finished with 8 oz. canvas jacket neatly pasted in place or factory pre-formed PVC jacket covers. Piping 1" or less shall have 1 1/2" thick insulation. Piping larger than 1" shall have 2" thick insulation. Piping exposed in occupied spaces and mechanical equipment rooms shall have canvas lagged in place for painting.
- c) Underground chilled and hot water supply and return piping shall be insulated with 1" thick urethane with a density of 3 lbs. per cubic foot. Fittings and valves shall be insulated with the same material and thickness as adjacent runs of pipe. Pipe insulation shall be installed with all joints butted. Butt joints shall be coated with Koppers #50 Bitumastic at a rate of 1 gallon per 50 sq. ft. of coating. After 4 hours, apply a second coat of #50 Bitumastic and embed a second layer of glass fiber into the mastic. After 4 hours, apply a final coat of Bitumastic to completely cover the glass fabric.
- d) All condenser water piping, fittings, valves, elbows, etc., above grade shall be insulated with 4 lb. density snap-on type glass fiber pipe insulation in molded sections with factory applied all service jacket. Seams shall be closely butted together and secured by self-sealing or pasting the all service lap. Fittings insulation shall be milled pre-fabricated of same material and thickness as on adjacent pipe. Exposed fittings shall be finished with 8 oz. canvas jacket neatly pasted in place or factory pre-formed PVC jacket covers. Piping 1 1/4" or less shall have 1" thick insulation. Piping larger than 1 1/4" shall have 1 1/2" thick insulation. Piping exposed in occupied spaces and mechanical equipment rooms shall have canvas lagged in place for painting.
- e) All condensate drain piping, make-up water piping, all refrigerant suction piping, and all refrigerant piping exposed on the exterior of the building shall be insulated with 1.5" wall tubular closed cell elastomeric insulation with all joints butted and cemented tight. Insulation shall be Rubatex R-180-FS or equal. Cover exterior insulation with aluminum jacket.
- f) All steam and condensate piping, fittings, valves, elbows, etc., above grade shall be insulated with 4 lb. density snap-on type glass fiber pipe insulation in

molded sections with factory applied all service jacket. Seams shall be closely butted together and secured by self-sealing or pasting the all service lap. Fittings insulation shall be milled pre-fabricated of same material and thickness as on adjacent pipe. Exposed fittings shall be finished with 8 oz. canvas jacket neatly pasted in place or factory pre-formed PVC jacket covers. Piping 1 ½” or less shall have 1 ½” thick insulation. Piping larger than 1 ½” shall have 3” thick insulation. Piping exposed in occupied spaces and mechanical equipment rooms shall have canvas lagged in place for painting.

3. Equipment

- a) All equipment associated with the chilled water operation such as air separator, chiller (if not factory insulated), etc. shall be insulated with one inch thick 6 p.c.f. dense foam rubber insulation such as Armstrong Armaflex 22 or approved equal. The insulated surfaces shall be covered with eight-ounce canvas pasted in place and glue sized twice for painting. Canvas shall be coated twice with Foster fireproof lagging to assure specified flame and smoke spread ratings.
- b) All equipment associated with the hot water operation such as air separators, converters, etc. shall be insulated with 2 ½” thick, high density fiberglass insulation such as Ultralite or approved equivalent by Owens-Corning or Johns-Manville. The insulated surface shall be covered with eight-ounce canvas as described in Paragraph B.1 about.
- c) All equipment associated with steam such as steam to hot water converter, etc., shall be insulated with 2” of calcium silicate insulation and covered with 30 lb. felt covering.

C. EXECUTION

1. Insulation shall be installed in accordance with manufacturer’s recommendations.
2. All exterior piping insulation above grade shall be provided with a protective aluminum jacket with a factory-applied asphalt and kraft paper moisture barrier. Aluminum jackets shall be cross-crimped (longitudinally corrugated) for strength. Aluminum jackets shall be not less than 0.106” thick and shall be secured with aluminum or stainless steel screw; not more that 8” apart.
3. All piping exposed outdoors shall be wrapped with electric trace before insulation is applied. Heat trace shall be equal be self-regulating with hard-wired power connection. See plans for wattage and voltage.
4. No chilled water shall be allowed to circulate prior to completion of insulation.
5. Any pipe covered prior to leak testing shall be exposed at contractor expense.
6. All piping shall be provided with identification in accordance with ANSI A13.1-1981 standards. Markers shall be located at each wall, floor or ceiling penetration, and at every 20 ft. Markets shall be fully legible from floor level

showing medium contained pipe, and direction flow. Wording on markers shall be as follows:

- a. Hot Water Supply
- b. Hot Water Return
- c. Chilled Water Supply
- d. Chilled Water Return
- e. Low Pressure Steam
- f. Condensate Return
- g. Condenser Water Supply Return
- h. Condenser Water Return

END OF SECTION 230700

SECTION 230800 – MECHANICAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning

Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:

1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper functional performance of equipment and systems.
3. Verify that O&M documentation left on site is complete.
4. Verify that the Owner's operating personnel are adequately trained.

1.2 RELATED WORK

- A. Section 23 0900 – Instrumentation and Controls for HVAC

1.3 ABBREVIATIONS AND DEFINITIONS

- A. A/E: Architect, Architect/Engineer, Engineer and/or Design-Builder
- B. ASI: Architectural Supplemental Instruction
- C. BAS: Building Automation System
- D. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- E. CxA: Commissioning Authority
- F. CC: Controls Contractor
- G. CM: Construction Manager
- H. Cx: Commissioning

- I. Cx Plan: Commissioning Plan
- J. DDC: Direct Digital Control System
- K. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
- L. FT: Functional Performance Test
- M. MC: Mechanical Contractor
- N. O&M: Operation and Maintenance
- O. OPM: Owner Project Manager
- P. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
- Q. PC: Prefunctional Checklist
- R. Sub(s): Subcontractors or Prime Contractor
- S. TAB: Test, Adjust and Balance

1.4 MECHANICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. Mechanical Systems

1. All 4-pipe variable air volume air handling units
2. Air Cooled chiller and pumps
3. Gas fired condensing boilers and pumps.
4. Test, Adjust, and Balance of HVAC air systems.
5. Exhaust Fans

B. Building Automation Systems (BAS)

1. The entire BAS shall be subject to commissioning, including all hardware components, software, networking, programming and engineering services, and controls documentation.
2. Any systems connected to the BAS (monitoring or otherwise) are subject to be commissioned including water meters.

1.5 SUBMITTALS

- A. Provide the CxA a copy of the following items, for the systems to be commissioned:
1. Equipment and System Submittals to include, at minimum, the following:
 - a. Equipment Data Sheets
 - b. Performance data
 - c. Manufacturer's pre-startup checklists
 - d. Manufacturer's start-up checklists
 - e. Installation Instructions
 2. Test, Adjust, and Balance (TAB) Reports
 - a. Planning Report - TAB contractor shall submit one copy of planning report (execution plan) to the CxA for review prior to beginning TAB work. At a minimum this report should include:
 - 1) Certifications on all instruments to be used throughout the testing. Certification must be documented within the previous 6 months.
 - 2) Résumés and Certification of individuals who will be balancing the systems.
 - 3) Detailed step-by-step plans for each procedure to be performed by the TAB Contractor.
 - 4) Sample forms to be used for each measurement.
 - b. Initial Test Report – Prior to starting final Balance Phase, submit a copy of the initial test report (TAB punchlist) to the CxA to indicate problem areas to be resolved before final balance is completed.
 - c. Final Report – Submit one copy of final test report to the CxA within 7 days after fieldwork is complete.
 3. Shop drawings (including any resubmittals required by the A/E)
 4. Piping - Supply one copy of all hydrostatic pressure test results
 5. Initial Pre-startup and start-up plan
 6. Startup Testing Report
 - a. Prepare startup testing report on a per system basis, documenting the results of executed testing plan.

- b. Copies of all completed test forms and checklists shall be provided.
 - c. List of all outstanding deficiencies and uncompleted items.
- 7. Operational and maintenance documentation
 - 8. Training plan and training materials
 - 9. As-built documentation

1.6 SEQUENCE OF OPERATIONS

- A. See Mechanical plans for more information.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

2.2 Cx WEB-BASED COMMISSIONING TOOL

- A. All web-based software required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Prior to the start of construction, the mechanical and controls contractor will schedule a meeting with the commissioning authority to review the systems to be commissioned, the testing methodology, and other requirements.

3.2 START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. General

- 1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
- 2. The prefunctional performance test checklists shall be developed by the CxA.

B. Start-up and Initial Checkout Plan

1. The subcontractor responsible for providing and installing the equipment shall develop the full start-up plan by combining the prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checkout and inspection of each piece of equipment and a summary statement with a signature block at the end of the checklist.
2. The full start-up plan shall consist of:
 - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
 - b. The manufacturer's normally used field checkout sheets
 - c. Specifically, the mechanical start-up plan shall also include the contractors TAB plan.
3. The contractor submits the full startup plan to the CxA for review and approval.
4. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

C. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment. It is the intent that the commissioning authority will observe the tests during contractor testing. If the contractor does not inform the commissioning authority of testing, the commissioning authority may request the contractor to repeat the test.
3. The CxA will observe the physical start-up of all major systems.
4. For lower-level components of equipment, (e.g., sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
5. The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA.

6. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
7. Completed startup test report must be provided to CxA prior to functional testing.

D. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to functional testing and demonstration for equipment and system in this division. The functional testing check list shall be developed by the CxA.

B. The general list of equipment and systems to be commissioned is found in section 1.4.

C. Objectives and Scope

1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
2. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a specified system response. Verifying each sequence in the sequence of operation is required.
3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc.

Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.

D. Development of Test Procedures

1. The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems related to feasibility, safety, equipment and warranty protection.

E. Coordination and Scheduling

1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Further, mechanical system functional testing shall not be scheduled until the final TAB report is approved and all reported deficiencies by TAB firm are corrected. Scheduling of functional testing shall be done with a minimum of two weeks notice prior to testing. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Test Methods

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions

and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

4. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.
6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

G. Demonstration, Verification and Validation

1. TAB Validation

- a. The air balancing is de-bugged, completed and approved before the CxA completes a TAB validation of air-related and water-related equipment or systems. The CxA will direct a TAB checkout by verifying the values reported in the final TAB report. The contractor shall supply all personnel and equipment for the checkout, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. The TAB verification shall verify:
 - 1) Grilles, diffusers, and registers
 - 2) All terminal devices, air and water
 - 3) All main HVAC systems.
 - 4) All exhaust fans
 - 5) All pumps
 - 6) Boilers and Chiller

2. Metering System

- a. Demonstrate meters are calibrated in accordance with the manufacturer's published data approved.
- b. Demonstrate accuracy of all meters.
- c. Demonstrate utility monitoring integration with BAS.

H. Problem Solving

1. The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. In addition to Installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment.

3.6 TRAINING OF OWNER PERSONNEL

- A. CxA shall document the completion of comprehensive Owner training. Training shall include the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment or system.
- B. Training shall include classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including all HVAC Systems, Controls, Exhaust Fans, etc.

END OF SECTION

SECTION 230900 – BUILDING AUTOMATION SYSTEM

PART 1 - General

1.1 Related Documents

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

1.2 Related Sections

- A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components, including open protocol control components for terminal heating and cooling units.

1.3 Standard Terms

A. Standard

1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers
2. AHU: Air Handling Unit
3. BACnet: Building Automation Controls Network
4. BMS: Building Management System
5. DDC: Direct Digital Control
6. EIA: Electronic Industries Alliance
7. GUI: Graphical User Interface
8. HVAC: Heating, Ventilation, and Air Conditioning
9. IEEE: Institute Electrical Electronic Engineers
10. MER: Mechanical Equipment Room
11. PID: Proportional, Integral, Derivative
12. VAV: Variable Air Volume Box

B. Communications and protocols

1. ARP: Address Resolution Protocol
2. CORBA: Common Object Request Broker Architecture
3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
4. DDE: Dynamic Data Exchange
5. FTT: Free Topology Transceivers
6. HTTP: Hyper Text Transfer Protocol
7. IIOP: Internet Inter-ORB Protocol
8. LAN: Local Area Network
9. LON: Echelon Communication – Local Operating Network

10. MS/TP: Master Slave Token Passing
11. ODBC: Open Database Connectivity
12. ORB: Object Request Broker
13. SNVT: Standard Network Variables Types
14. SQL: Structured Query Language
15. UDP: User Datagram Protocol
16. XML: eXtensible Markup Language

C. Controllers

1. ASD: Application Specific Device
2. AAC: Advanced Application Controller
3. ASC: Application Specific Controller.
4. CAC: Custom Application Controller.
5. DCU: Distributed Control Unit
6. LCM: Local Control Module
7. MC: MicroControllers
8. MCI: MicroInterface
9. NSC: Network Server Controller
10. PPC: Programmable Process Controller
11. SDCU: Standalone Digital Control Units
12. SLC: Supervisory Logic Controller
13. UEC: Unitary Equipment Controller
14. VAVDDC: Variable Air Volume Direct Digital Controller

D. Tools and Software

1. AMBCx: Automated Monitoring Based Commissioning
2. APEO: Automated Predictive Energy Optimization
3. DR: Demand Response
4. CCDT: Configuration, Commissioning and Diagnostic Tool
5. BPES: BACnet Portable Engineering Station
6. LPES: LON Portable Engineering Station
7. POT: Portable Operator's Terminal

1.4 Qualifications of Bidder

- A. Control building automation systems shall be by the Schneider Electric factory branch in Morrisville, NC. Contact person is Tom Monroe, tom.monroe@se.com
- B. The control system shall be by Schneider Electric SmartStruxure system.

1.5 Scope of Work

- A. The Contractor shall furnish and install a complete building automation system including all necessary hardware and all operating and applications software necessary to perform the control sequences of operation as called for in this specification or drawing notes. All components of the system – workstations, servers, application controllers, unitary controllers, etc. shall communicate using the BACnet protocol, as defined by ASHRAE Standard 135-2007, or EIA standard 709.1, the LonTalk™ protocol, or Modbus protocol. The only exception will be field controllers within the Schneider I/NET, Continuum, and NETWORK 8000 family. No gateways shall be used for communication to controllers furnished under this section.
- B. Except as otherwise noted, the control system shall consist of all necessary Ethernet Network Controllers, Standalone Digital Control Units, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system.
- C. The BAS contractor shall review and study all HVAC drawings and the entire specification to familiarize themselves with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
- D. All interlocking wiring, wiring and installation of control devices associated with the equipment listed below shall be provided under this Contract. When the BAS system is fully installed and operational, the BAS Contractor and representatives of the Owner will review and check out the system – see System Acceptance and Testing section of this document. At that time, the BAS contractor shall demonstrate the operation of the system and prove that it complies with the intent of the drawings and specifications.
- E. Provide services and manpower necessary for check out and testing of the system in coordination with the HVAC Contractor, Balancing Contractor and Owner’s representative.
- F. All work performed under this section of the specifications will comply with all governing codes, laws and governing bodies. If the drawings and/or specifications are in conflict with governing codes, the Contractor, with guidance from the engineer, shall submit a proposal with appropriate modifications to the project to meet code restrictions. If this specification and associated drawings exceed governing code requirements, the specification will govern. The Contractor shall obtain and pay for all necessary construction permits and licenses.

1.6 System Description

- A. In accordance to the scope of work, the system shall also provide a graphical, web-based, operator interface that allows for instant access to any system through a standard browser. The contractor must provide PC-based programming workstations, operator workstations and microcomputer controllers of modular design providing distributed processing capability, and allowing future expansion of both input/output points and processing/control functions.

For this project, the system shall consist of the following components:

1. Administration and Programming Workstation(s): Unless already existing on the customer main site, the BAS Contractor shall furnish (qty) Administration and Programming Workstation Computers as described in Part 2 of the specification. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable.
 2. Web-Based Operator Workstations: The BAS Contractor shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
 3. Ethernet-based Network Router and/or Network Server Controller(s): The BAS Contractor shall furnish Ethernet-based Network Server Controllers as described in Part 2 of the specification. These controllers will connect directly to the Operator Workstation over Ethernet at a minimum of 100mbps, and provide communication to the Standalone Digital Control Units and/or other Input/Output Modules. Network Server Controllers shall conform to BACnet device profile B-BC. Network controllers that utilize RS232 serial communications or ARCNET to communicate with the workstations will not be accepted. Network Controllers shall be tested and certified by the BACnet Testing Laboratory (BTL) as Network Server Controllers (B-BC).
 4. Standalone Digital Control Units (SDCUs): Provide the necessary quantity and types of SDCUs to meet the requirements of the project for mechanical equipment control including air handlers, central plant control, and terminal unit control. Each SDCU will operate completely standalone, containing all of the I/O and programs to control its associated equipment. BACnet SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL).
- B. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Modbus, XML and HTTPS for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Server Controllers (NSCs), user workstations and a local host computer system.
- C. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
- D. The system shall enable an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol and/or ANSI / ASHRAE™ Standard 135-2007, BACnet functionality to assure interoperability between all system components. Native support for the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2007, BACnet protocol are required to assure that

the project is fully supported by the HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs.

- E. The system shall enable an architecture that utilizes a MS/TP selectable 9.6-76.8 Kbaud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2008, BACnet functionality to assure interoperability between all system components. The AAC shall be capable of communicating as a MS/TP device or as a BACnet IP device communicating at 10/100 Mbps on a TCP/IP trunk. The ANSI / ASHRAE™ Standard 135-2008, BACnet protocol is required to assure that the project is fully supported by the leading HVAC open protocol to reduce future building maintenance, upgrade, and expansion costs.
- F. LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth where necessary or desired.
 - 1. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guide functionality lines for such encapsulation and shall be based on industry standard protocols.
 - 2. The products used in constructing the BMS shall be LonMark™ compliant.
 - 3. In those instances in which Lon-Mark™ devices are not available, the BMS contractor shall provide device resource files and external interface definitions for LonMark devices.
- G. The software tools required for network management of the LonTalk™ protocol and the ANSI / ASHRAE™ Standard 135-2008, BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans and are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 4; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet IP or MS/TP. Physical connection of LonWorks devices shall be via Ethernet IP or FTT-10A.
- H. The system shall support Modbus TCP and RTU protocols natively, and not require the use of gateways.
- I. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.
 - 1. The supplied system must incorporate HTML5 and NOT require Java. Browser access that requires Java-enabled browsers will not be accepted.
 - 2. Data shall reside on a supplier-installed server for all database access.
 - 3. 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.
- J. All work described in this section shall be installed, wired, and circuit tested by factory certified technicians qualified for this work and in the regular employment of the approved

manufacturer's local field office. The approved manufacturer's local field office shall have a minimum of 10 years of installation experience with the manufacturer and shall provide documentation in the bid and submittal package verifying longevity of the installing company's relationship with the manufacturer when requested. Supervision, hardware and software engineering, and checkout of the system shall be by the employees of the approved manufacturer's local field office and shall not be subcontracted. The control contractor shall have an in place support facility within 150 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have 24 hours/day, 7 days/week emergency service available.

- K. Provide the Commissioning, configuration and diagnostic tool (CCDT), color display personal computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC) monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.
- L. Provide (existing) the Commissioning, configuration and diagnostic tool (CCDT), color display personnel computer, software, and interfaces to provide uploading/downloading of High Point Count Controllers (AAC), Unitary Equipment Controllers (UEC) and VAV controllers (VAVDDC), monitoring all BACnet objects, monitoring overrides of all controller physical input/output points, and editing of controller resident time schedules.
- M. The system shall have the capability to provide a web-based AMBCx (automated monitoring based commissioning) system. The AMBCx system shall be able to interface directly with the project BAS and energy/performance metering system to provide information on HVAC systems that are being controlled.
- N. The system shall have the capability to provide a web-based APEO (automated predictive energy optimization) system and enable effective participation in local utility Demand Response (DR) programs. The vendor shall provide software and ongoing services that will identify actionable energy saving and peak reduction opportunities to assist the facility in achieving its energy and sustainability objectives, and automatically and continuously operate the systems necessary to achieve the targeted savings and reductions.

1.7 Work by Others

- A. The BAS Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others' work.
- B. The BAS Contractor shall furnish all control valves, sensor wells, flow meters and other similar equipment for installation by the Mechanical Contractor unless scheduled or specified to be provided with the equipment.

1.8 Code Compliance

- A. Provide BAS components and ancillary equipment, which are UL-916 listed and labeled.
- B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.
- C. All wiring shall conform to the National Electrical Code.
- D. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.
- E. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.9 Submittals

- A. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the drawings, the Contractor shall furnish a CD containing the identical information.
- B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.
- C. Submittal data shall contain manufacturer's data on all hardware and software products required by the specification. Valve, damper and air flow station schedules shall indicate size, configuration, capacity and location of all equipment.
- D. Submittals shall contain narrative descriptions of sequences of operation. Diagrams shall be on 11" by 17" foldouts.
- E. Submit five (5) electronic copies and (2) hardcopies of submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor, prior to submitting, shall check all documents for accuracy.
- F. The Engineer will make corrections, if required, and return to the Contractor.
- G. The following is a list of post construction submittals that shall be updated to reflect any changes during construction and re-submitted as "As-Built".
 - 1. System architecture drawing.
 - 2. Layout drawing for each control panel
 - 3. Wiring diagram for individual components
 - 4. System flow diagram for each controlled system
 - 5. Instrumentation list for each controlled system
 - 6. Sequence of control
 - 7. Operation and Maintenance Manuals
- H. Information common to the entire system shall be provided. This shall include but not be limited to the following.
 - 1. Product manuals for the key software tasks.
 - 2. Operating the system.
 - 3. Administrating the system.
 - 4. Engineering the operator workstation.

5. Application programming.
 6. Engineering the network.
 7. Setting up the web server.
 8. Report creation.
 9. Graphics creation.
 10. All other engineering tasks.
 11. System Architecture Diagram.
 12. Reference the product manual that includes instructions on executing the task.
 13. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 14. Licenses, guarantees, and warranty documents for equipment and systems.
 15. Submit one copy for each building, plus two extra copies.
- I. Information common to the systems in a single building shall be provided.
1. System architecture diagram for components within the building annotated with specific location information.
 2. As-built drawing for each control panel.
 3. As-built wiring design diagram for all components.
 4. Installation design details for each I/O device.
 5. As-built system flow diagram for each system.
 6. Sequence of control for each system.
 7. Product data sheet for each component.
 8. Installation data sheet for each component.
 9. Submit two copies for each building and two extra copies.
- J. Software shall be provided:
1. Submit a copy of all software installed on the servers and workstations.
 2. Submit all licensing information for all software installed on the servers and workstations.
 3. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
 4. Submit all licensing information for all of the software used to execute the project.
 5. All software revisions shall be as installed at the time of the system acceptance.
 6. Firmware Files
 7. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project.
 8. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
 9. Submit a copy of all application files that were created during the execution of the project.
 10. Submit a copy of all graphic page files created during the execution of the project.

1.10 Coordination

- A. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," "Miscellaneous Integrated systems" and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems. It is expected that qualified vendor representatives will be present during startup for any of the above mentioned integrations as required. Costs for this support should be covered by the associated vendor as part of their base bid.
- B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- C. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- D. Coordinate with the Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.

1.11 Ownership

- A. The Owner shall retain licenses to software for this project.
- B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition off this contractor. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software.
- C. The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future. Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- D. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
 - 1. Server and workstation software
 - 2. Application programming tools
 - 3. Configuration tools
 - 4. Network diagnostic tools
 - 5. Addressing tools
 - 6. Application files
 - 7. Configuration files
 - 8. Graphic files
 - 9. Report files
 - 10. Graphic symbol libraries
 - 11. All documentation

1.12 Quality Assurance - System Startup and Commissioning

- A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the owner indicating that the installed system functions in accordance with the plans and specifications.
- B. The BAS contractor shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives.
- C. The BAS Contractor shall provide a technician up to 3 days manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building. The BAS Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his contract.
- D. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test completion. Any deviations from the submitted installation plan shall also be recorded.
- E. Required elements of the startup testing include:
 - 1. Measurement of voltage sources, primary and secondary
 - 2. Verification of proper controller power wiring.
 - 3. Verification of component inventory when compared to the submittals.
 - 4. Verification of labeling on components and wiring.
 - 5. Verification of connection integrity and quality (loose strands and tight connections).
 - 6. Verification of bus topology, grounding of shields and installation of termination devices.
 - 7. Verification of point checkout.
 - 8. Each I/O device is landed per the submittals and functions per the sequence of control.
 - 9. Analog sensors are properly scaled and a value is reported
 - 10. Binary sensors have the correct normal position and the state is correctly reported.
 - 11. Analog outputs have the correct normal position and move full stroke when so commanded.
 - 12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.
 - 13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
 - 14. Documentation of Loop tuning (sample rate, gain and integral time constant).
- F. A Startup and Testing Report shall be provided upon test completion.

1.13 Warranty and Maintenance

- A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

1.14 Training

- A. The BAS Contractor shall provide on-site training to the Owner's representative and maintenance personnel per the following description:
- B. On-site training shall consist of a minimum of (4) hours of hands-on instruction geared at the operation and maintenance of the systems. The curriculum shall include
1. System Overview
 2. System Software and Operation
 3. System access
 4. Software features overview
 5. Changing setpoints and other attributes
 6. Scheduling
 7. Editing programmed variables
 8. Displaying color graphics
 9. Running reports
 10. Workstation maintenance
 11. Viewing application programming
 12. Operational sequences including start-up, shutdown, adjusting and balancing.
 13. Equipment maintenance.

PART 2 - Products

2.1 Control system shall be SmartStruxure system with SmartX IP, Room Controllers, Network 8000, or I/A BACnet or LON field controls by Schneider Electric – contact for controls questions is Tom Monroe tom.monroe@se.com

- A. Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:
1. Electric Components

- a. Schneider-Electric and Veris Field Devices
- 2. Electronic Components
 - a. Schneider-Electric and Veris Field Devices
- 3. Direct Digital Control Systems Devices:
 - a. Schneider-Electric I/A BACnet.

2.2 System Architecture

A. General

1. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
2. An Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks.
3. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
4. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
5. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, LonWorks IP, and/or Modbus TCP protocol.
6. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported. A sub-network of SDCUs using the BACnet MS/TP, LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.

B. TCP/IP Level

1. The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the campus firewall. Fixed IP addresses for connections to the campus WAN shall be used for each device that connects to the WAN.

C. Fieldbus Level with Standalone Digital Control Units (SDCUs)

1. The fieldbus layer shall support all the following types of SDCUs:
 - a. BACnet IP SDCU requirements: The system shall consist of one or more BACnet IP field buses managed by the Network Server Controller. Minimum

speed of not less than 100Mbps. The field bus controllers shall support daisy chain topology of up to 50 controllers. The field bus controllers shall also support, where applicable, RSTP loop whereby up to 39 controllers are supported. These devices shall support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.

- b. BACnet MS/TP SDCU requirements: The system shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2007. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
- c. LonWorks SDCU requirements: The system shall consist of one or more LonWorks FTT-10A field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer shall consist of up to 64 Lonworks SDCUs using peer-to-peer, event-driven communication for operation of HVAC and lighting equipment. If using TAC Xenta controllers, a total combination of Xenta and LonWorks SDCUs should consist of up to 64 in total, with a maximum of 30 for the Xenta line. If using I/A MNL controllers only, you may have up to 127 SDCUs per field bus level.
- d. Modbus SDCU requirements: The system shall consist of one or more Modbus RTU (RS-485 or RS-232) field buses managed by the Network Server Controller. The field bus layer shall consist of up to 31 SDCUs for operation of HVAC, power metering, and lighting equipment. If utilizing Modbus TCP, the field bus layer shall consist of up to 100 SDCUs for operation of HVAC, power metering, and lighting equipment. The NSCs shall be capable of at least two Modbus RTU field buses for a total capability of 62 SDCUs per NSC.
- e. NETWORK 8000 SDCU requirements: The system shall consist of one or more ASD or LCM field buses managed by the Network Server Controller. The field bus layer shall consist of up to 128 ASD SDCUs or 31 LCM SDCUs for operation of HVAC, power metering, and lighting equipment.
- f. I/NET SDCU requirements: The system shall consist of one or more controller LANs and subLANs managed by the Network Server Controller. The network shall consist of up to 100,000 I/NET points capable through numerous links and devices for operation of HVAC, power metering, and lighting equipment.

D. BAS LAN Segmentation

- 1. The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.

E. Standard Network Support

1. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.

F. System Expansion

1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
2. Web-based operation shall be supported directly by the NSCs and require no additional software.
3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.

G. Support For Open Systems Protocols

1. All Network Server Controllers must natively support the BACnet IP, BACnet MS/TP, LonWorks FTT-10, Modbus TCP, Modbus RTU (RS-485 and RS-232), and Modbus ASCII protocols.

2.3 Operator Workstation Requirements

A. General

1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 10 concurrent operator users and/or 2 concurrent engineering users within the enterprise server.
2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
3. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
4. A minimum of 1 Workstation shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are

accomplished to the databases within the NSC. Systems with a central database will not be acceptable.

B. Administration/Programming Workstation & Enterprise Server Requirements

1. The Enterprise Server (existing) shall consist of the following:
 - a) Processor
 1. Minimum: Intel Core i5 @ 2.0 GHz or equivalent
 2. Recommended: Intel Core i5 @ 3.0 GHz or better
 - b) Memory
 1. Minimum: 4GB
 2. Recommended: 8GB or higher
 - c) Operating systems:
 1. Microsoft Windows 7 64-bit
 2. Microsoft Windows 10 64-bit
 3. Microsoft Windows Server 2012 R2 64-bit
 4. Microsoft Windows Server 2016
 5. Microsoft Windows Server 2019
 - d) 10/100MBPS Ethernet NIC
 - e) Storage
 1. Minimum: 100GB
 2. Recommended: 1TB
 3. Solid State Drive recommended
 - f) Required additional software:
 1. Microsoft .Net 4.7.2 and later
 - g) License agreement for all applicable software
 - h) External log storage option
 1. PostgreSQL 11.0 and later
 2. TimescaleDB 1.2 and later
2. The workstation (existing) shall consist of the following:
 - a) Processor
 1. Minimum: Intel Core i5 @ 2.0 GHz or equivalent
 2. Recommended: Intel Core i5 @ 3.0 GHz or better
 - b) Memory
 1. Minimum: 4GB
 2. Recommended: 8GB or higher
 - c) Operating systems:
 1. Microsoft Windows 7 64-bit
 2. Microsoft Windows 10 64-bit
 3. Microsoft Windows Server 2012 R2 64-bit
 4. Microsoft Windows Server 2016
 5. Microsoft Windows Server 2019

- d) 10/100MBPS Ethernet NIC
- e) Storage
 - 1. Minimum: 20GB
 - 2. Recommended: 1TB
 - 3. Solid State Drive recommended
- f) Required additional software:
 - 1. Microsoft .Net 4.7.2 and later
- g) License agreement for all applicable software

C. Web-Based Operator PC Requirements

1. Any user on the network can access the system, using the following software:
 - a) Minimum:
 1. Google Chrome 61 or higher
 2. Mozilla Firefox 60 or higher
 3. Microsoft Edge (EdgeHTML) 16 or higher
 4. Safari 11.1 or higher
 - b) Recommended:
 1. Google Chrome 71 or higher
 2. Mozilla Firefox 64 or higher
 3. Microsoft Edge (EdgeHTML) 17 or higher
 4. Safari 11.4 or higher

D. General Administration and Programming Workstation Software

1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
3. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information will be available in graphic or text displays stored at the NSC. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.

E. User Interface:

1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be

configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.

2. System shall be able to automatically switch between displayed metric vs. imperial units based on the workstation/webstations localization.
3. The BMS workstation/webstations shall be capable of multiple language display, including English, Spanish, German, French, Japanese, Finnish, Portuguese, Swedish, Russian, and traditional and simplified Chinese. The multiple languages shall not require additional add on software from the standard workstation installer and shall be selectable within said workstation.
4. Servers and clients shall have the ability to be located in different time zones, which are then synchronized via the NTP server.

F. User Security

1. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon Microsoft Windows Security Domains that enable the customer IT department to assist in user access.

G. Configuration Interface

1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created from the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The

system shall also maintain a link to all “child” objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.

H. Color Graphic Displays

1. The system shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
 - a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
 - b. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
 - c. The editor shall use Scalable Vector Graphics (SVG) technology.
 - d. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, and graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
 - e. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
 - f. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
 - g. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
 - h. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
 - i. Graphics should rescale based on whatever monitor or viewing device is being used.
 - j. Be able to create graphics on varying layers that can be moved and repeated.
 - k. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.

3. Additionally, the Graphics Editor portion of the Engineering Software shall provide the following capabilities:
 - a. Create and save pages.
 - b. Group and ungroup symbols.
 - c. Modify an existing symbol.
 - d. Modify an existing graphic page.
 - e. Rotate and mirror a symbol.
 - f. Place a symbol on a page.
 - g. Place analog dynamic data in decimal format on a page.
 - h. Place binary dynamic data using state descriptors on a page.
 - i. Create motion through the use of animated .gif files or JavaScript.
 - j. Place test mode indication on a page.
 - k. Place manual mode indication on a page.
 - l. Place links using a fixed symbol or flyover on a page.
 - m. Links to other graphics.
 - n. Links to web sites.
 - o. Links to notes.
 - p. Links to time schedules.
 - q. Links to any .exe file on the operator work station.
 - r. Links to .doc files.
 - s. Assign a background color.
 - t. Assign a foreground color.
 - u. Place alarm indicators on a page.
 - v. Change symbol/text/value color as a function of an analog variable.
 - w. Change a symbol/text/value color as a function of a binary state.

 - x. Change symbol/text/value as a function of a binary state.
- l. Automatic monitoring
 1. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.
- J. Alarm Management
 1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
 2. Alarm management features shall include:
 - a. A minimum of 1000 alarm notification levels. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.

- b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement)
- c. Playing an audible sound on alarm initiation or return to normal.
- d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software integrated with the operating system's mail application interface (MAPI). No special software interfaces shall be required and no email client software must be running in order for email to be distributed.
- e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-6pm, Mon-Fri) and to a Central Alarming workstation at all other times.
- f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
- g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
- h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
- i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
- j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
- k. An operator shall have the capability to assign an alarm to another user of the system.

K. Report Generation

- 1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
- 2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
- 3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used.
- 4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.

5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
6. All reports shall be able to be set up to automatically run or be generated on demand.
7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
 - a. Activities Per Server Report
 - b. Activities Per User Report
 - c. Alarm Amount by Category Report
 - d. Alarm Amount by Type Report
 - e. Alarms Per Sever Report
 - f. Current Alarm Report
 - g. Most Active Alarm Report
 - h. System Errors Per Server Report
 - i. Top Activities Report
 - j. Top Alarms Report
 - k. Top System Errors Report
 - l. Trend Log Comparison Report
 - m. User Logins Report
 - n. Users and Groups Reports
13. Minimum Energy Reports shall include:
 - a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
 - b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
 - c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.

L. Scheduling

1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.

3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment

1. Programming in the NSC shall be either in graphical block format or line-programming format or both.
2. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. The programmer's environment will include access to a superset of the same programming language supported in the SDCUs.
4. NSC devices will support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs.
5. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
6. It shall be possible to view graphical programming live and real-time from the Workstation.
7. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
8. Key terms should appear when typing (IntelliType).
9. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different function.

10. The system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.

N. Saving/Reloading

1. The workstation software shall have an application to save and restore NSC and field controller memory files.
2. For the NSC, this application shall not be limited to saving and reloading an entire controller – it must also be able to save/reload individual objects in the controller. This allows off-line debugging of control programs, for example, and then reloading of just the modified information.

O. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
4. It shall be capable to search and view all forced values within the system.

P. Fault Tolerant Enterprise Server Operation (Top level NSC)

1. A single component failure in the system shall not cause the entire system to fail. All system users shall be informed of any detectable component failure via an alarm event. System users shall not be logged off as a result of a system failure or switchover.

Q. Web-based Operator Software

1. General:
 - a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
 - b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
2. Graphic Displays
 - a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
 - b. Through the browser interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller.

Changes are effective immediately to the controller, with a record of the change stored in the system database.

3. Alarm Management

- a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
- b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

R. Groups and Schedules

1. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
2. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.

S. User Accounts and Audit Trail

1. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
2. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

T. Web Services

1. The installed system shall be able to use web services to “consume” information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable.
 - a. Shall be able to “consume” data into the system via SOAP and REST web services.

2.4 Network Server Controllers (NSCs)

- A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
- B. The BACnet NSC shall be classified as a “native” BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).

- C. The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
- D. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler.
- E. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.
- F. It 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 by means of an Internet site including automatic synchronization
 - 6. Native integration of LonWorks controller data and Modbus controller data or BACnet controller data and Modbus controller data
 - 7. Network Management functions for all LonWorks based devices
- G. Hardware Specifications
 - 1. Memory:
 - a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
 - 2. Each NRC shall provide the following on-board hardware for communication:
 - a. One 10/100bT Ethernet for communication to Workstations, other NRCs and onto the Internet
 - b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
 - c. One TP/FT port for communication to LonWorks devices.
 - d. One Device USB port
 - e. Two host USB Ports
 - 3. The NSC shall conform to a small footprint no larger than 100W x 125H x 75D mm (3.94W x 4.92H x 2.95D in).
- H. Modular Expandability:
 - 1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.

2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

I. Universal Input Temperatures

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
 - 1) 10 kohm Type I (Continuum)
 - 2) 10 kohm Type II (I/NET)
 - 3) 10 kohm Type III (Satchwell)
 - 4) 10 kohm Type IV (FD)
 - 5) Linearized 10 kohm Type V (FD w/11k shunt)
 - 6) Linearized 10 kohm (Satchwell)
 - 7) 1.8 kohm (Xenta)
 - 8) 1 kohm (Balco)
 - 9) 20 kohm (Honeywell)
 - 10) 2.2 kohm (Johnson)
2. In addition to the above, the system shall be capable of using the below RTD sensors, however it is not required that all universal inputs be compatible with them.
 - 1) PT100 (Siemens)
 - 2) PT1000 (Sauter)
 - 3) Ni1000 (Danfoss)

J. Local Status Indicator Lamps:

1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

K. Real Time Clock (RTC):

1. Each NSC shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.

L. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.

2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

M. Automatic Restart After Power Failure:

1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.

N. Battery backup:

1. The NSC shall include an on-board battery to back up the controller's RAM memory. The battery shall provide accumulated backup of all RAM and clock functions for at least 30 days. In the case of a power failure, the NSC shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the NSC shall restart itself from its application program stored in its FLASH memory.

O. Software Specifications

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

P. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a "canned" program method will not be accepted.

Q. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:
 - a. Proportional, Integral plus Derivative Control (PID)
 - b. Two Position Control
 - c. Digital Filter
 - d. Ratio Calculator
 - e. Equipment Cycling Protection

R. Mathematical Functions:

1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

S. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Night Setback Control
8. Enthalpy Switchover (Economizer)
9. Peak Demand Limiting
10. Temperature Compensated Duty Cycling
11. CFM Tracking
12. Heating/Cooling Interlock
13. Hot/Cold Deck Reset
14. Hot Water Reset
15. Chilled Water Reset
16. Condenser Water Reset
17. Chiller Sequencing

T. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.

2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.

U. Alarm Management:

1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

V. Embedded Web Server

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.

2.5 BACnet Fieldbus and BACnet SDCUs

A. Networking

1. IP Network: All devices that connect to the WAN shall be capable of operating at 10 megabits per second or 100 megabits per second.

2. IP To Field Bus Routing Devices

- a. A Network Server Controller shall be used to provide this functionality.
- b. These devices shall be configurable locally with IP crossover cable and configurable via the IP network.
- c. The routing configuration shall be such that only data packets from the field bus devices that need to travel over the IP level of the architecture are forwarded.

B. Field Bus Wiring and Termination

1. The wiring of components shall use a bus or daisy chain concept with no tees, stubs, or free topology.
2. Each field bus shall have a termination resistor at both ends of each segment.

C. Repeaters

1. Repeaters are required to connect two segments.
2. Repeaters shall be installed in an enclosure. The enclosure may be in an interstitial space.

D. Field Bus Devices

1. General Requirements

- a. Devices shall have a light indicating that they are powered.
- b. Devices shall be locally powered. Link powered devices (power is furnished from a central source over the field bus cable) are not acceptable.
- c. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)

E. Network Server Controllers (NSCs)

- a. If NSCs have embedded I/O, all of the requirements for I/O that are described under Advance Application Controllers shall apply.
- b. Shall support the export of data to NSCs from other vendors that support the data sharing, read property service.
- c. Shall support the export of data using Change of Value (COV) initiation to NSCs from other vendors that support the subscription to data using the COV concept.
- d. Shall support the export of data to any BACnet OWS that supports the data sharing, read property service.
- e. Shall support the export of data using Change of Value (COV) initiation to any BACnet OWS that supports the subscription to data using the COV concept.
- f. Shall provide trend log support for all of the devices on the field bus. They shall provide sufficient memory to store up to 300 samples for each variable required to be trended by the sequence of control.
- g. Shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
- h. Shall provide time schedule support for all of the devices on the field bus.

- i. Shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
- j. Shall provide alarm message initiation for all alarms conditions from any of the field bus devices.
- k. Shall deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the notification.
- l. Shall support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement.
- m. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
- n. Shall support the receipt and response to Time Synchronization commands from any device that supports the BACnet service for initiating time synchronization commands.
- o. Shall support the “Who is?” and “I am.” BACnet service.
- p. Shall support the “Who has?” and “I have.” BACnet service.
- q. Shall support Backup and Restore commands from any BACnet OWS that supports the initiation of Backup and Restore commands.
- r. Shall be BTL certified.

F. Advance Application Controllers (AAC)

- 1. The key characteristics of a AAC are:
 - a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
 - b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
 - c. The application to be executed by a AAC is created by an application engineer using the vendor’s application programming tool.
 - d. If local time schedules are embedded, the AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
 - e. If local trend logging is embedded, the AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
 - f. If local alarm message initiation is embedded, the AAC shall:

- 1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient of the alarm message.
- 2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,
- g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
- h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
- i. Shall support the “Who is” and “I am.” BACnet services.
- j. Shall support the “Who has” and “I have.” BACnet services.
2. Analog Input Circuits
 - a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.
 - b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
 - c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
 - d. For non-linear sensors such as thermistors and flow sensors the AAC shall provide software support for the linearization of the input signal.
3. Binary Input Circuits
 - a. Dry contact sensors shall wire to the controller with two wires.
 - b. An external power supply in the sensor circuit shall not be required.
4. Pulse Input Circuits
 - a. Pulse input sensors shall wire to the controller with two wires.
 - b. An external power supply in the sensor circuit shall not be required.
 - c. The pulse input circuit shall be able to process up to 20 pulses per second.
5. True Analog Output Circuits
 - a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).

- b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.
- 6. Binary Output Circuits
 - a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
 - b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.
- 7. Program Execution
 - a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
 - b. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.
- 8. Local Interface
 - a. The controller shall support the connection of a portable interface device such as a laptop computer or vendor unique hand-held device. Via this local interface, an operator shall be able to:
 - 1) Adjust application parameters.
 - 2) Execute manual control of input and output points.
 - 3) View dynamic data.

G. Application Specific Devices

- 1. Application specific devices shall have fixed function configurable applications.
- 2. If the application can be altered by the vendor's application programmable tool, the device is an advanced application controller and not an application specific device.
- 3. Application specific devices shall be BTL certified

2.6 DDC Sensors and Point Hardware

A. Temperature Sensors

- 1. Acceptable Manufacturers: Veris Industries
- 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 enclosure made of high impact ABS plastic for mounting on a standard electrical box. Basis of Design: Veris TW Series

- 1) 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.
- 2) 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 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 Industries
2. Transmitters shall be accurate to +/- 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 be available with an integrated temperature sensor
13. Basis of Design: Veris HWL Series

C. Humidity Duct Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to $\pm 2\%$ 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 be available with an integrated temperature sensor
12. Basis of Design: Veris HD Series

D. Humidity Outdoor Transmitter

1. Acceptable Manufacturer: Veris Industries
2. Transmitters shall be accurate to $\pm 2\%$ 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.
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 be available with an integrated temperature sensor
12. Basis of Design: Veris HO Series

E. Carbon Dioxide Wall Transmitter:

1. Acceptable Manufacturer: Veris Industries
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval.
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: 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 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. Transmitter shall be available with an integrated [humidity sensor] [temperature sensor]
13. Basis of Design: Veris CWL

F. Carbon Dioxide Duct Transmitter:

1. Acceptable Manufacturer: Veris Industries
2. Sensor type shall be Non-dispersive infrared (NDIR).
3. Accuracy shall be ± 30 ppm $\pm 2\%$ of measured value with annual drift of ± 10 ppm. Minimum five year recommended calibration interval.
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
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
14. Transmitter shall be available with an integrated [humidity sensor] [temperature sensor]
15. Basis of Design: Veris CDL

G. Air Pressure Transmitters.

1. Acceptable Manufacturers: Veris Industries
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 Manufacturer: Veris Industries
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 $\pm 1\%$ F.S. and $\pm 2\%$ F.S. for lowest selectable range
 - b. Long term stability shall be $\pm 0.25\%$
 - 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
 - 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 available as 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 manufacturer is Veris Industries

J. Current Status Switches

1. Acceptable Manufacturer: Veris Industries
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. Liquid Flow, Insertion Type Turbine Flowmeter:

1. Acceptable Manufacturer: Veris Industries
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:
 - 1) Accuracy $\pm 1\%$ of rate over optimum flow range; ≥ 10 upstream and ≥ 5 downstream straight pipe diameters, uninterrupted flow
 - 2) Repeatability $\pm 0.5\%$
 - 3) Velocity Range: 0.3 to 20 FPS
 - 4) Pressure Drop 0.5 psi or less @ 10 ft/sec for all pipe sizes 1.5" dia and up
 - 5) Pressure Rating: 1000 psi @ 70°F
4. Maximum Temperature Rating: 300°F
5. Materials: Stainless Steel or Brass body; Stainless steel impeller
6. Transmitter:
 - 1) Power Supply: 12 - 30VAC or 8 - 35VDC.
 - a) Output: [Frequency] [4-20 mA] [Scaled Pulse]
 - 2) Temperature Range: 14° to 150°F
 - 3) Display: 8 character 3/8" LCD (Optional)
 - 4) Enclosure: NEMA 4, Polypropylene with Viton® sealed acrylic cover
7. Basis of Design: Veris SDI series

L. Liquid Flow/Energy Transmitter, Non-invasive Ultrasonic (Clamp-on):

1. Acceptable Manufacturer: Veris Industries
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:
 - 1) 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
 - 2) Flow Repeatability $\pm 0.01\%$ of reading
 - 3) 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
 - 4) Flow Sensitivity 0.001 FPS
 - 5) Temperature Accuracy (energy): 32-212°F; Absolute 0.45°F; Difference 0.18°F
 - 6) Temperature Sensitivity: 0.05°F
 - 7) Temperature Repeatability: $\pm 0.05\%$ of reading
 - 6. Transmitter:
 - 1) Power Supply: 95 to 264 VAC, 47 to 63 Hz or 10 to 28 VDC.
 - 2) Output: [RJ45] [Modbus TCP/IP] [Ethernet/IP] [BACnet/IP] [Pulse] [4-20 mA] [RS-485 Modbus RTU]
 - 3) Temperature Range: -40 to +185°F
 - 4) Display: 2 line backlit LCD with keypad
 - 5) 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
- M. Analog Electric/Pneumatic Transducer:
- 1. Acceptable Manufacturer: Veris Industries
 - 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:
 - 1) Accuracy: 1% full scale; combined linearity, hysteresis, repeatability
 - 2) Compensated Temperature Range: 25° to 140°F
 - 3) Temp Coefficient: $\pm 0.05\%^\circ\text{C}$
 - 4) 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
- N. Control Valves
- 1. Provide automatic control valves suitable for the specified controlled media (steam, water or glycol). Equip control valves with the 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.

2. 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.
3. Trim material shall be stainless steel for steam and high differential pressure applications.
4. Electric actuation should be provided on all terminal unit reheat applications unless electric heat is provided.
5. Basis of design: Schneider Electric valve assemblies

O. Dampers

1. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blade as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS Contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet Metal Contractor.
2. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
3. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
4. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.
5. Control and smoke dampers shall be Ruskin, or approved equal.
6. Provide opposed blade dampers for modulating applications and parallel blade for two position control.

P. Damper Actuators

1. Damper actuators shall be 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 or electrical capacitance type, 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.

Q. Airflow Measuring Stations

1. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors.
2. 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.

2.7 Electrical Power Measurement

A. Electrical Power Monitors, Single Point (Easy Install):

1. Acceptable Manufacturer: Veris Industries.
2. General: Consist of three split-core CTs, factory calibrated as a system, hinged at both axes with the electronics embedded inside the master CT. The transducer shall measure true (rms.RMS) power demand real power (kW) consumption (kWh). Conform to ANSI C12.1 metering accuracy standards.
3. Voltage Input: Load capacity as shown on drawings. 208-480 VAC, 60 Hz
4. Maximum Current Input: Up to 2400A
5. Performance:
 - 1) Accuracy: +/- 1% system from 10% to 100% of the rated current of the CT's
 - 2) Operating Temperature Range: 32-140°F, 122°F for 2400A.
6. Output: 4 to 20 mA, Pulse. or Modbus RTU
7. Ratings:
 - 1) Agency: UL508 or equivalent
 - 2) Transducer internally isolated to 2000 VAC.
 - 3) Case isolation shall be 600 VAC.
8. Basis of Design: Similar to Hawkeye Veris H80xx40 series
9. Accessories: [BACnet] [LON] communications gateway

B. Electrical Power Monitors, Single Point (High Accuracy):

1. Acceptable Manufacturer: Veris Industries.
2. General: Revenue grade meter. Measures voltage, amperage, real power (kW), consumption (kWh), and reactive power (kVARar), and power factor (PF) per phase and total load for a single load. Factory calibrated as a system using split core CT's. Neutral voltage connection is required.
3. Voltage Input: 208-480 VAC, 60 Hz
4. Current Input: Up to 2400A
5. Performance:
 - 1) Accuracy: +/- 1% system from 2% to 100% of the rated current of the CT's
 - 2) Operating Temperature Range: 32-122°F
6. Output: Pulse, BACnet, Modbus RTU
7. Display: Backlit LCD
8. Enclosure: NEMA 1
9. Agency Rating: UL508 or equivalent
10. Basis of Design: Veris Industries H81xx00 series.

C. Electrical Power Monitors, Single Point (High Accuracy/Versatility):

1. Acceptable Manufacturer: Veris Industries.
2. General: Revenue grade meter. Measures voltage, amperage, real power (kW), consumption (kWh), reactive power (kVAR), apparent power (kVA) and power factor (PF) per phase and total load for a single load. Available with data logging , Bi-directional (4-quadrant) metering, and pulse contact accumulator inputs.

3. Voltage Input: 90-600 VAC, 50/60 Hz, 125-300 VDC
 4. Current Input: 5A – 32,000A, selectable 1/3V or 1V CT inputs
 5. Performance:
 - 1) Accuracy shall be +/- [0.2%] [0.5%] revenue grade
 - 2) Operating Temperature Range: -22-158°F
 6. Output shall be [Pulse] [BACnet] [Modbus RTU] [LON]
 7. Display: Backlit LCD
 8. Enclosure: NEMA 4x optional
 9. Agency Rating: UL508, ANSI C12.20
 10. Basis of Design: Veris E5xxx series.
- D. Electrical Power Monitors, Multiple Point (92 loads, High Accuracy):
1. Acceptable Manufacturer: Veris Industries.
 2. General: Revenue grade meter. Measures volts, amps, power and energy for each circuit. 1/4 amp to 200 amp monitoring. 4 configurable alarm threshold registers
 3. Voltage Input: 90-277 VAC, 60 Hz
 4. Current Input: 5A – 32,000A, 1/3V CT inputs
 5. Performance:
 - 1) Accuracy: +/- 0.5% meter (split core), +/- 1% system from 1/4-100A (solid core)
 - 2) Operating Temperature Range: 32-140°F
 6. Output: Modbus RTU
 7. Agency Rating: UL508, ANSI C12.10, IEC Class 1
 8. Basis of Design: Veris E3xxx series.

PART 3 - Execution

3.1 Contractor Responsibilities

A. General

1. Installation of the building automation system shall be performed by the Contractor or a subcontractor. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete. Under no circumstances shall the design, scheduling, coordination, programming, training, and warranty requirements for the project be delegated to a subcontractor.

B. Code Compliance

1. All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.

C. Cleanup

1. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this contract.

3.2 Wiring, Conduit, and Cable

A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	Per Mfr.	300 Volt
Class Three	Per Mfr.	300 Volt
Communications	Per Mfr.	Per Mfr.

- B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
- C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
- D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.
- E. Flexible metallic conduit shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.
- F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.
- G. Where allowed by code the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings.
- H. Fiber optic cable shall include the following sizes; 50/125, 62.5/125 or 100/140.
- I. Only glass fiber is acceptable, no plastic.
- J. Fiber optic cable shall only be installed and terminated by an experienced contractor. The BAS contractor shall submit to the Engineer the name of the intended contractor of the fiber optic cable with his submittal documents.

3.3 Hardware Installation

- A. Installation Practices for Wiring
- B. All controllers are to be mounted per the manufacturer's installation documentation.

- C. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
- D. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
- E. Wires are to be attached to the building proper at regular intervals such that wiring does not droop. Wires are not to be affixed to or supported by pipes, conduit, etc.
- F. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
- G. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
- H. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
- I. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
- J. Wire will not be allowed to run across telephone equipment areas.

3.4 Installation Practices for Field Devices

- A. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
- B. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
- C. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
- D. For duct static pressure sensors, the high pressure port shall be connected to a static pressure probe inserted into the duct. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
- E. For building static pressure sensors, the high pressure port shall be inserted into the space via a static pressure pick-up. Pipe the low pressure port to the outside of the building.

3.5 Enclosures

- A. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
- B. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
- C. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated.

- D. All wiring to and from the FIP will be to screw type terminals or lever nuts. Analog or communications wiring may use the FIP as a raceway without terminating.
- E. All outside mounted enclosures shall meet the NEMA-3R rating.

3.6 Identification

- A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
- B. All field enclosures, other than controllers, shall be labeled.
- C. Junction box covers will be marked to indicate that they are a part of the BAS system.
- D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be labeled.
- E. All I/O field devices inside FIP's shall be labeled.

3.7 Existing Controls.

- A. Existing controls which are to be reused must each be tested for proper operation. Existing controls which are to be reused and are found to be defective requiring replacement, will be noted to the Owner. The Owner will be responsible for all material and labor costs associated with their repair.

3.8 Control System Switch-over

- A. Demolition of the existing control system will occur after the new temperature control system is in place including new sensors and new field interface devices.
- B. Switch-over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch-over.
- C. The Contractor shall minimize control system downtime during switch-over. Sufficient installation mechanics will be on site so that the entire switch-over can be accomplished in a reasonable time frame.

3.9 Location

- A. The location of sensors is per mechanical and architectural drawings.
- B. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
- C. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
- D. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.10 Software Installation

- A. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

3.11 Database Configuration.

- A. The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

3.12 Color Graphic Displays.

- A. Unless otherwise directed by the owner, the Contractor will provide color graphic displays as depicted in the mechanical drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for setpoint changes as required by the owner.

3.13 Reports.

- A. The Contractor will configure a minimum of 4 reports for the owner. These reports shall, at a minimum, be able to provide:
 1. Trend comparison data
 2. Alarm status and prevalence information
 3. System user data

3.14 Point to Point Checkout.

- A. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the owner or owner's representative.

3.15 Controller and Workstation Checkout.

- A. A field checkout of all controllers and front end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software.

3.16 System Acceptance Testing

- A. All application software will be verified and compared against the sequences of operation.
- B. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint.

- C. Test alarms in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.).
- D. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended.
- E. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.

End of Section 230900

SECTION 20993 – SEQUENCE OF OPERATIONS

A. GENERAL

1. Related Sections

- a. SECTION 23 09 00 BAS Instrumentation and Control for HVAC

B. PRODUCTS

- a. Not applicable

C. EXECUTION

1. GENERAL

- a. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.
- b. When an air handling unit is not in operation, control devices shall remain in their “off” positions. “Off” positions may differ from the “normal” (meaning failed) position. Except as specified otherwise, “off” and “normal” positions of control devices shall be as follows:

Device	“OFF” POSITION	“NORMAL” POSITION
HEAT COIL VALVE	OPEN	OPEN
COOLING COIL VALVE	CLOSED	CLOSED
STEAM COIL VALVES	CLOSED	CLOSED
OUTSIDE AIR DAMPER	CLOSED	CLOSED
RETURN AIR DAMPER	OPEN	OPEN
EXHAUST/RELIEF DAMPER	CLOSED	CLOSED

- c. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified “proportional only” or “P+I”, Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.
- d. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule all required controllers and sequences. Set up initial schedules in coordination with owner.
- e. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:
 - 1) Occupied Period: period of time when the building is in use and occupied. Generally systems will be fully operational throughout this period and ventilation air shall be continuously introduced. Space temperature setpoints will generally be in the “normal” range of 70°-74°F +/- 2°F.
 - 2) Unoccupied period: period of time when the building or zone is not in use and unoccupied. Ventilation air shall not be introduced. Space temperature setpoints will generally be in the “normal” range of 65°-78°F +/- 2°F.
 - 3) Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to “normal” or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling. Time period shall be determined by an optimum start strategy unless otherwise specified.
 - 4) Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a “setback” temperature, economization may be enabled to maintain “setback” cooling setpoint when applicable.

- f. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5-second (adj.) intervals to minimize inrush current.
- g. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level, from the Operator interface. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- h. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, one of the following methods shall be employed:
 - 1) Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.
 - 2) A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.
 - 3) Primary variable shall control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices shall still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term shall be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Contractor shall gain prior approval for implementing this method of reset.
- i. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on aperiodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of “need heat” or “need cool” requests from

individual SCU's. A SCU's "need heat" virtual point shall activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU's "need cool" virtual point shall activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range

- j. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:
 - 1) A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.
 - 2) Alternatively, to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the "need heat" or "need cool" virtual point shall increment by one unit each time a zone's valve/damper position rises to greater than 95% (adj.). The quantity of "need heat" or "need cool" points shall then be the basis for reset.
 - 3) Where "prove operation" of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS shall, after an adjustable time delay after the device is commanded to operate (feedback delay) , confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce

delay) while the device is commanded to run, an alarm shall be enunciated audibly. Upon failure, run command shall be removed and the device shall be locked out until the alarm is manually acknowledged unless specified otherwise.

- k. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
 - 1) Speed control of variable speed drives
 - 2) Control Reset Loop
 - 3) Valve Travel Limit.
- l. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.
- m. VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hard wired versus integrated through a direct interface.
- n. Demand Limiting: The BAS shall broadcast the current demand level and adjust the current heating and cooling temperature setpoints as follows based on the current demand level:
 - 1) Demand Level 0: The space temperature setpoints shall not be adjusted.
 - 2) Demand Level 1: The heating setpoint shall be decreased by 1°F (adj.) & the cooling setpoint shall be increased by 1°F (adj.).
 - 3) Demand Level 2: The heating setpoint shall be decreased by 2°F (adj.) & the cooling setpoint shall be increased by 2°F (adj.).

- 4) Demand Level 3: The heating setpoint shall be decreased by 3°F (adj.) & the cooling setpoint shall be increased by 3°F (adj.). 3.02

2. AIR HANDLING UNITS - GENERAL

- a. Logic Strategies: The BAS shall fully control the air handlers. Generally the BAS shall energize the AH (start the fans and activate control loops) as dictated for each air handler. The following indicates when and how the BAS shall energize the AHs and control various common aspects of them. The following “logic strategies” shall be included by reference with each air handler with any specific clarifications required:
- b. Scheduled Occupancy: BAS shall determine the occupancy periods (occupied, unoccupied, preoccupancy, and setback) as defined above. The following details the common control aspects related to the scheduled occupancy. The BAS shall display the applicable mode or “cause” for the unit operating. Reference the BAS control specifications (graphics) for more information on how this should be displayed.
- c. Occupied Period: BAS shall energize the AH during all occupied periods. Note that the beginning of the occupancy period shall be set sufficiently before the actual start of occupancy to obtain the required building component of ventilation per ASHREA 62. Specific times shall be as directed by the A/E. Minimum OA flow setpoint shall be as scheduled on the drawings. “Normal” setpoints shall apply.
- d. Unoccupied Period: Minimum OA flow shall be 0 CFM and the minimum OA damper position shall be 0%. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. The unoccupied period and the preoccupancy period will typically overlap.
- e. Setback Period: the BAS shall deenergize the unit except as required to maintain a setback temperature as indicated in the individual sequences with a 5°F cycle differential. Generally, where setback temperatures apply in multiple zones, the worst zone shall control the system. Setback setpoints generally apply except during preoccupancy. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. Generally, during heating setback, cooling

shall be disabled. During cooling setback, both heating and cooling shall be enabled.

- f. Preoccupancy: BAS shall energize the AH continuously during the preoccupancy period. Minimum OA flow shall be 0 CFM or the minimum OA damper position shall be 0%. “Normal” space setpoints shall apply for the connected terminal units. Preoccupancy duration shall be optimized so that the preset start time is minimized but all zones achieve setpoint at the start of the occupied period. The BAS shall continuously adjust to the preoccupancy period (up to a user defined maximum amount of time) to optimized the preoccupancy start period. Generally, during warm-up mode, cooling shall be disabled. During morning cooldown, both heating and cooling shall be enabled.
- g. Sequenced Heating and Cooling: BAS shall control the heating and cooling coils and air side economizer as detailed for the particular AH. Program logic shall directly prohibit the heating and cooling valves as well as the heating valve and economizer damper to be open (or above minimum) simultaneously. This does not apply to cooling and reheat valves that are used simultaneously for dehumidification.
- h. Airside Economizer: BAS shall modulate the mixing dampers to provide “free cooling” when conditions merit. The free cooling shall generally be staged before any mechanical cooling. While conditions merit, dampers shall be modulated in a DA PID loop to maintain mixed air temperature at a setpoint as specified for the individual unit. Economizer logic shall remain enabled during setback cooling, where applicable. Economizer mode shall be active while:
 - 1) The unit is energized and status has been proven for at least 15seconds (adj.).
 - 2) AND, when outside air temperature falls below the switching setpoint of 68°F (adj.), with 1°F (adj.) cycle differential
 - 3) AND, when outside air temperatures are above 45°F (adj.), with 1°F (adj.) cycle differential.
 - 4) AND, when outside air enthalpy is less than 28 BTU/lb

- i. Mixed Air Low Limit Override: BAS shall override the signal to the OA & RA dampers via a proportional only loop to maintain a minimum mixed air temperature. The maximum allowed output of the OA/RA dampers shall drop from 100% to 0% as the mixed air temperature drops from 47°F to 42°F (all values being adjustable).
- j. Freeze Safety: Shall be provided by hardwired freeze stat with manual reset.
- k. Smoke/Fire Safety: Upon indication of smoke or fire by the Fire Alarm system (via a relay provided by the FAS contractor), the BAS shall deenergize the AH via a hard wired interlock. All dampers shall revert to their normal "Off" positions unless specifically indicated otherwise. The BAS shall enunciate the appropriate alarm; then remove and lock out the unit start command until the alarm condition is cleared.
- l. High Pressure Safety: Upon activation of a high pressure safety switch, AH shall be deenergized via a hard wired interlock and an indication of the operation shall be indicated at the BAS. The BAS shall enunciate the appropriate alarm; then remove and lock out the unit start command until the alarm condition is cleared.
- m. Demand Control Ventilation: The OA damper shall modulate between minimum damper position and reduced minimum damper position based on combination of space CO2 sensors in training rooms and conference rooms and RA CO2 when economizer mode is not enabled. When economizer is enabled, it shall have priority over the damper position and CO2 control shall not be active. The minimum OA and reduced OA ventilation (50% of min OA) requirements shall be specified by the engineer, damper positions established by the air balancer, and BAS programmed by the BAS contractor. Engineer shall ensure that specified minimum and reduced minimum damper position setpoints are adequate to maintain building pressure slightly positive at all times. The initial CO2 setpoint shall be 1000 ppm with a 400 ppm operating span. When the CO2 value is below the CO2 PPM setpoint as measured by the RA CO2 sensor for 60 min. (adj), the OA damper shall reset from "Minimum" position to the "Reduced Minimum" position. When the CO2 value is above the CO2 PPM setpoint (adj.) as measured by the RA CO2 sensor for 30 min. (adj.), the OA damper shall reset from "Reduced Minimum" to the "Minimum" position. If CO2 continues to rise the o/a shall be further opened in 10% increased o/a flows as measured by the outside air monitoring station every 15 minutes till setpoint is maintained. Upon a fall in

CO2 below setpoint o/a shall return to minimum position. This is typically a "proportional only" control loop as the OA damper should not modulate until it's above or below setpoint. Economizer mode shall remain typical as a PI or PID Loop.

- n. Supply Air Static Pressure Reset Control: Reset duct static pressure set point(s) higher or lower between maximum and minimum set points based on BAS optimization logic that uses the terminal unit air damper positions. The set point(s) shall be increased to maintain all dampers at less than 95% open. The set points(s) shall be decreased to maintain minimum of one damper at no less than 90% open. Initial and minimum setpoints shall be recommended by the TAB Contractor and approved by the Engineer. Maximum set points shall be equal to the initial setpoints plus 0.50 inches. Reset set point in 15 minute increments.
- o. Humidity Control: Upon a rise in humidity level above 65% (adjustable) and until relative humidity drops to 60%, as senses by the return duct humidity sensor, the cooling coil control valve shall modulate to provide 55 deg F discharge air temperature. The unit fan speed, terminal box position, and reheat coil control valve shall be modulated to maintain space temperature 1 deg lower than the cooling setpoint.
- p. Filter Pressure: A differential pressure sensor across the filter shall be monitored and signal an alarm when pressure drop exceeds 1.0" (adj.)
- q. The detailed "logic strategies" above shall be required by reference to the min each of the individual sequences specified below.

3. VAV AHU WITH PH & CHW COIL, RETURN FAN

- a. Supply Fan: BAS shall control the starting and stopping of the supply fan as follows:
 - 1) Start/Stop: BAS shall command the operation of the supply fan and it shall run continuously whenever the AH is "energized" as specified for the applicable logic strategies specified in item "Air Handling Units - General".
 - 2) Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, BAS shall enunciate an alarm.

- 3) VSD Control: Whenever the fan is energized, BAS shall control the speed of the VSD to maintain the supply duct static pressure setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
 - 4) VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
 - 5) Supply Duct Static Pressure Setpoint:
 - (a) Setpoint shall be reset between the limits of .5" to 2" as to maintain pressure requests of the VAV boxes with all values adjustable. Value shall be set by Test and Balance Sub Contractor.
 - (b) BAS shall utilize a Sample and Bump output strategy or other similar loop output or logic to reset the static setpoint.
 - (c) Reset values shall be adjusted for optimized building and energy performance.
- b. Return Fan: BAS shall control the starting and stopping of the return fan as follows:
- 1) Start/Stop: BAS shall command the operation of the return fan and it shall run continuously whenever the AH is "energized" as specified for the applicable logic strategies specified in item "Air Handling Units - General" and the supply fan status has been proven on for at least 5 seconds(adj.).
 - 2) Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, BAS shall enunciate an alarm.
 - 3) VSD Control: Whenever the fan is energized and the unit is operating in the Occupied mode, BAS shall control the speed of the VSD based on a tracking algorithm as defined below.

- (a) TAB contractor shall determine the following 4 values:
 - (i) Supply Fan Max: The speed at which the supply fan will typically operate when all connected terminal units are at their maximum flow setpoints
 - (ii) Supply Fan Min: The speed at which the supply fan will typically operate when all connected terminal units are at their minimum flow setpoints
 - (iii) Return Fan Max: The speed at which the return fan will typically need to operate when all connected terminal units are at their maximum flow setpoints
 - (iv) Return Fan Min: The speed at which the return fan will typically need to operate when all connected terminal units are at their minimum flow setpoints
- 4) The BAS shall modulate the return fan speed as follows:
 - (a) When the speed of the supply fan is less than the Supply Fan Min value, the return fan speed shall be the output of a linear reset loop that is reset from 0% to the Return Fan Min value as the supply fan speed increases from 0% to the Supply Fan Min value.
 - (b) When the speed of the supply fan is greater than the Supply Fan Min value but not greater than the Supply Fan Max value, the return fan speed shall be the output of a linear reset loop that is reset from the Return Fan Min value to the Return Fan Max value as the supply fan speed increases from the Supply Fan Min value to the Supply Fan Max value
 - (c) When the speed of the supply fan is greater than the Supply Fan Max value, the return fan speed shall be the output of a linear reset loop that is reset from the Return Fan Max value to 100% as the supply fan speed increases from the Supply Fan Max value to 100%. Note that this stage will not apply if Supply Fan Max value or the Return Fan Max value equals 100%.
 - (d) The return fan speed shall be limited so that it is never commanded to a speed that is more than 20% (adj.) above or 20% (adj.) below the speed of the supply fan.

- 5) On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
- 6) During Unoccupied mode of operation, the Return Fan Speed shall be the same as the Supply Fan Speed.
- 7) VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
- 8) Outside Air (OA)/ Return Air (RA)/ Relief (Rel) Dampers: BAS shall control the dampers as follows:
 - (a) Closed: When AH is deenergized, dampers shall remain in their "off" positions. When AH is energized during unoccupied period the minimum OA flow setpoint will be 0 cfm which will close the OA damper unless economizer is available.
 - (b) Minimum OA Control: The OA damper shall modulate between minimum damper position and reduced minimum damper position based on combination of space CO2 sensors in training rooms and conference rooms and RA CO2 when economizer mode is not enabled. When economizer is enabled, it shall have priority over the damper position and CO2 control shall not be active. The minimum OA and reduced OA ventilation (50% of min OA) requirements shall be specified by the engineer, damper positions established by the air balancer, and BAS programmed by the BAS contractor. Engineer shall ensure that specified minimum and reduced minimum damper position setpoints are adequate to maintain building pressure slightly positive at all times. The initial CO2 setpoint shall be 1000 ppm with a 400 ppm operating span. When the CO2 value is below the CO2 PPM setpoint as measured by the RA CO2 sensor for 60 min. (adj), the OA damper shall reset from "Minimum" position to the "Reduced Minimum" position. When the CO2 value is above the CO2 PPM setpoint (adj.) as

measured by the RA CO2 sensor for 30 min. (adj.), the OA damper shall reset from "Reduced Minimum" to the "Minimum" position. If CO2 continues to rise the o/a shall be further opened in 10% increased o/a flows as measured by the outside air monitoring station every 15 minutes till setpoint is maintained. Upon a fall in CO2 below setpoint o/a shall return to minimum position. This is typically a "proportional only" control loop as the OA damper should not modulate until it's above or below setpoint. Economizer mode shall remain typical as a PI or PID Loop.

- (c) Relief Control: BAS shall modulate the Rel damper to maintain the Relief plenum pressure at setpoint. Setpoint shall initially be set at 0.2" w.c. (adj.).
 - (d) Economizer: BAS shall modulate the OA/RA & Rel dampers per the Airside economizer strategy to maintain the mixed air temperature at setpoint. The mixed air setpoint shall be equal to the discharge air temperature setpoint (specified herein) minus 3°F (adj.). The dampers shall modulate open per the higher of the economizer PID loop output and:
 - (i) The Minimum OA flow control output described above (for the OA & RA dampers only).
 - (ii) The Relief Control output described above (for the Rel Damper).
 - (e) Mixed Air Low Limit: Per the mixed air low limit logic strategy, the OA and RA dampers' position shall be limited to prevent the mixed air temperature from falling below the low limit setpoint. The limit shall override the output from the economizer and minimum OA flow control loop outputs.
- 9) Space Temperature Control: The space temperatures shall be controlled via individual VAV boxes.
- 10) Discharge Temperature Control: The discharge temperature setpoint shall be set to the lower of the following:
- (a) The BAS shall utilize a Sample and Bump output strategy or other similar loop output/logic to calculate a resultant value based on the

number of “need cooling” requests from associated VAV terminal units. The Upper and lower limits of this reset setpoint shall initially be set to 65°F and 58°F (both adjustable), respectively. The output of this loop shall input to a dehumidification loop as the high limit of its reset range (see below).

- (b) A dehumidification loop shall be A Proportional only loop output reset from the high limit output from the temperature reset loop (as described above) to 55°F (adj.) as the return air humidity rises from 55% to 65% (both adjustable).
- (c) The resultant temperature output after passing through the two loops (as described above) shall be the effective discharge temperature setpoint. This value shall be trended, alarmed (vs actual temperature) and shown on the BAS graphic.
- (d) All reset values shall be adjusted for optimized building and energy performance.

11) Preheating Section:

- (a) HW Heating Valve: N.O. valve shall modulate per the higher of
 - (i) a PID loop to maintain a leaving coil temperature at 52°F (adj.), and
 - (ii) a proportional only loop that is reset from 0 to 100% as the preheat air temperature drops from 48°F (adj.) to 40°F (adj.).
- (b) Heating Loops shall remain active even when the AHU is not enabled.
- (c) Freeze Condition: Whenever a freeze condition is initiated (as described in item “Air Handling Units – General – Freeze Safety”, the HW valve shall be commanded to 100% open (adj.)

12) Cooling Section:

- (a) Cooling Coil Valve: Whenever the AHU is energized and status is proven ON, N.C. cooling coil valve shall modulate via a DA PID loop to maintain discharge temperature at setpoint.

- (b) During setback or morning warm-up modes, the ChW valve shall remain closed.
- (c) Whenever the unit is energized and the economizer mode is active, the chilled water valve shall remain closed unless the economizer dampers have been commanded to full open.
- (d) Freeze Condition: Whenever a freeze condition is initiated (as described in item “Air Handling Units – General – Freeze Safety”, the ChW valve shall be commanded to 100% open (adj.)
- (e) Occupancy Override: When the Occupancy Override button on any of the room sensors is depressed momentarily, the unit shall be indexed to the Occupied period for 60 min. (adj.)

4. SINGLE DUCT VAV AHU WITH ECONOMIZER – PREHEAT, CHW, REHEAT COILS

- a. Supply Fan: BAS shall control the starting and stopping of the supply fan as follows:
 - 1) Start/Stop: BAS shall command the operation of the supply fan and it shall run continuously whenever the AH is “energized” as specified for the applicable logic strategies specified in item “Air Handling Units - General”.
- b. Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, BAS shall enunciate an alarm.
- c. VSD Control: Whenever the fan is energized, BAS shall control the speed of the VSD to maintain the space temperature setpoints. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits. Fan will be set at two speeds only 50% and 100%.
- d. VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system’s graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.

e. Outside Air (OA)/ Return Air (RA)/ Relief (Rel) Dampers: BAS shall control the dampers as follows:

- 1) Closed: When AH is deenergized, dampers shall remain in their “off” positions. When AH is energized during unoccupied period the minimum OA flow setpoint will be 0 cfm which will close the OA damper unless economizer is available.
- 2) Minimum OA Control: OA damper shall modulate between minimum damper position and reduced minimum damper position based on RA CO₂ when economizer mode is not enabled. When economizer is enabled, it shall have priority over the damper position and CO₂ control shall not be active. The minimum OA and reduced OA ventilation (50% of min OA) requirements shall be specified by the engineer, damper positions established by the air balancer, and BAS programmed by the BAS contractor. Engineer shall ensure that specified minimum and reduced minimum damper position setpoints are adequate to maintain building pressure slightly positive at all times. The initial CO₂ setpoint shall be 1000 ppm with a 400 ppm operating span. When the CO₂ value is below the CO₂ PPM setpoint as measured by the RA CO₂ sensor for 60 min. (adj), the OA damper shall reset from "Minimum" position to the "Reduced Minimum" position. When the CO₂ value is above the CO₂ PPM setpoint (adj.) as measured by the RA CO₂ sensor for 30 min. (adj.), the OA damper shall reset from "Reduced Minimum" to the "Minimum" position. This is typically a "proportional only" control loop as the OA damper should not modulate until it's above or below setpoint. Economizer mode shall remain typical as a PI or PID Loop.”
- 3) Economizer: BAS shall modulate the OA, RA & Relief dampers per the Airside economizer strategy to maintain the mixed air temperature at setpoint. The mixed air setpoint shall be equal to the discharge air temperature setpoint (specified herein) minus 3°F (adj.). The dampers shall modulate open per the higher of the economizer PID loop output and the Minimum OA flow control output described above (for the OA & RA dampers only).
- 4) Mixed Air Low Limit: Per the mixed air low limit logic strategy, the OA, RA & Relief dampers’ position shall be limited to prevent the mixed air temperature from falling below the low limit setpoint. The

limit shall override the output from the economizer and minimum OA flow control loop outputs.

- f. Space Temperature Control: The space temperatures shall be controlled by varying fan speed and cooling and re-heat coil temperatures.
 - 1) Heating: When space temperature is below setpoint the reheat valve shall open to maintain space setpoint with fan a minimum speed. If space temperature continues to fall the fan shall index to high speed.
 - 2) Cooling: When space temperature is above setpoint the chilled water valve shall open with fan at low speed. If space temperature continues to rise the fan shall index to high speed.
 - 3) Dehumidification: Upon a rise in RA humidity above 60% (adj) the fan speed shall index to low speed and chilled water coil valve fully open. Space temperature shall be controlled by reheat control valve.
- g. Preheating Section:
 - 1) HW Heating Valve: N.O. valve shall modulate per the higher of
 - (a) a PID loop to maintain a leaving coil temperature at 52°F (adj.), and
 - (b) a proportional only loop that is reset from 0 to 100% as the preheat air temperature drops from 48°F (adj.) to 40°F (adj.)
 - 2) Heating Loops shall remain active even when the AHU is not enabled.
 - 3) Freeze Condition: Whenever a freeze condition is initiated (as described in item “Air Handling Units – General – Freeze Safety”, the HW valve shall be commanded to 100% open (adj.)
- h. Cooling Section:
 - 1) Cooling Coil Valve: Whenever the AHU is energized and status is proven ON, N.C. cooling coil valve shall modulate via a DA PID loop to maintain space temperature at setpoint.
 - 2) During setback or morning warm-up modes, the ChW valve shall remain closed.

- 3) Whenever the unit is energized and the economizer mode is active, the chilled water valve shall remain closed unless the economizer dampers have been commanded to full open.
 - 4) Freeze Condition: Whenever a freeze condition is initiated (as described in item “Air Handling Units – General – Freeze Safety”, the ChW valve shall be commanded to 100% open (adj.)
- i. Reheating Section:
 - 1) HW Heating Valve: N.O. valve shall modulate per the higher of
 - (a) a PID loop to maintain a leaving coil temperature at 70°F (adj.), and
 - (b) a proportional only loop that is reset from 0 to 100% as the space air temperature drops from 72°F (adj.) to 65°F (adj.)
 - 2) Heating Loops shall remain active even when the AHU is not enabled.
 - 3) Freeze Condition: Whenever a freeze condition is initiated (as described in item “Air Handling Units – General – Freeze Safety”, the HW valve shall be commanded to 100% open (adj.)
 - j. Occupancy Override: When the Occupancy Override button on any of the room sensors is depressed momentarily, the unit shall be indexed to the Occupied period for 60 min. (adj.)
 - k. Door switches for all roll-up doors shall be provided by the controls contractor. If door switch is open for longer than 30 minutes (adj) the units shall be set into unoccupied mode.

5. VAV DAMPER WITH REHEAT CONTROL

- a. General: Control shall be pressure independent with minimum, maximum and heating maximum flow setpoints, scheduled occupancy with optimum preoccupancy.
- b. Space Temperature Control: Four setpoints shall apply. Normal Heating (70°F adj.), Normal Cooling (74°F adj.), Setback Heating (65°F (adj.)), and setback cooling (78°F). These four values shall be the only values changed by the operator to adjust space temperature setpoint. All other dead bands, differentials, etc. shall be calculated in the program logic (unless another

means is provided to prohibit overlap of the heating and cooling loops and ensure a dead band such as function block templates that restrict the setpoint input).

- c. Occupancy Sensor / Standby mode: For all classrooms, the BAS shall monitor the occupancy sensor(s) that serve room(s) served by the terminal unit. If the (any) zone indicates occupancy the terminal unit shall control the normal space heating and cooling setpoints as described above. If occupancy is not indicated in the (all) zone(s) served by the terminal unit for a period of 2 mins (adj.), the zone shall enter standby mode. During the standby mode, separate standby heating and cooling setpoints shall be calculated and utilized for control.
- d. Standby space cooling setpoint: shall be the normal space cooling setpoint plus 3°F (adj.)
- e. Standby space heating setpoint: shall be the normal space heating setpoint minus 3°F (adj.)
- f. Zone Damper: Zone damper shall modulate in a PI loop to maintain zone volume setpoint. Zone volume setpoint shall be reset as follows based on the parent AHU Discharge Air Temperature:
 - 1) Whenever the parent AHU DAT is < 65°F (adj.), the following sequence shall apply:
 - (a) Cooling: The zone volume setpoint shall be reset between the minimum and the cooling maximum volume settings to maintain the space temperature at the cooling space temperature setpoint via a PID loop output. The zone volume setpoint shall be reset linearly between the minimum and cooling maximum volume setpoints as the loop output increases from 0 to 100%.
 - (b) Heating: The zone volume setpoint shall be reset between the minimum and the heating maximum volume settings to maintain the space temperature at the heating space temperature setpoint via a PID loop output. Note that a common space heating PID loop output will be used to reset the zone volume setpoint (in the heating mode) and the HW reheat valve (see below). The zone volume setpoint shall be reset linearly between the minimum and

heating maximum volume setpoints as the loop output increases from 15 to 100% (adj.).

- (c) Dead band: When the space temperature is between the effective space temperature heating and cooling setpoints (heating and cooling PID outputs are both at 0%), the zone volume setpoint shall remain at the minimum flow setpoint.
- (d) Whenever the parent AHU DAT is > 65°F (adj.), the following sequence shall apply:
 - (i) Cooling: The zone volume setpoint shall remain at minimum whenever the space temperature is above the cooling setpoint as no cooling is available in this mode.
 - (ii) Heating: The zone volume setpoint shall be reset between the minimum and the COOLING maximum volume settings to maintain the space temperature at the heating space temperature setpoint via a PID loop output. Note that a common space heating PID loop output will be used to reset the zone volume setpoint (in the heating mode) and the HW reheat valve (see below). The zone volume setpoint shall be reset linearly between the minimum and COOLING maximum volume setpoints as the loop output increases from 0 to 100% (adj.).
 - (iii) Dead band: When the space temperature is between the effective space temperature heating and cooling setpoints (heating and cooling PID outputs are both at 0%), the zone volume setpoint shall remain at the minimum flow setpoint.
 - (iv) Zone Volume flow setpoints shall be as scheduled on the drawings.
- g. Hydronic Reheat: Zone reheat coil valve shall modulate in a PID loop output (same loop output that resets the volume setpoint in the heating mode) to maintain the space temperature at the heating setpoint as defined above. The valve shall modulate from 0 to 100% on a PID loop output of 0-75% (adj.). The valve shall be closed whenever ALL the parent air units is off.

- h. Static Pressure Request: This terminal shall issue a “pressure request” as follows”
 - 1) Whenever the damper output is > 95%, a pressure request shall be issued
 - 2) Whenever the damper output falls below 90%, the pressure request shall stop
- i. Reports:
 - 1) Configure a tabular report using real-time data with the following column headings: VAV TERMINAL DESCRIPTION, ZONE TEMPERATURE, ZONE TEMPERATURE SETPOINT, PRIMARY AIR FLOW, PRIMARY AIR FLOW SETPOINT, DAMPER POSITION (0 to 100% open), REHEAT OUTPUT (0 to 100% heating), DISCHARGE AIR TEMPERATURE.
 - 2) At the top of the table, list building number, floor or area description if applicable, parent air handling unit designation, air handling unit down duct static pressure and air handler discharge air temperature.
 - 3) Reference the requirements for summary service screens in the Controls (graphics section) specification for additional information.

6. AIR COOLED CHILLER WITH PRIMARY AND SECONDARY PUMPS

- a. General: BAS shall fully control the chilled water systems and equipment and provide monitoring and diagnostic information for management purposes. BAS shall interface directly with the chiller and all available points shall be monitored and displayed via the operator interface. Refer to the control diagram for additional information.
- b. Cooling Enable: Cooling shall be enabled when any chilled water valve opens more than 20% continuously for 5 min. (adj.) and the outside air temperature is above 60°F (adj.). Once enabled, the chilled water system will operate for a minimum of 30 minutes. The chilled water system shall also be enabled whenever manually enabled by the operator at the operator interface.
- c. Cooling Disable: Cooling shall be disabled when all chilled water valves are less than 5% open continuously for 10 min. (adj.) or the outside air

temperature is below 60°F. The chilled water system shall also be disabled whenever manually disabled by the operator at the operator interface.

d. Secondary Pump Control

1) Start/Stop: Whenever the system is enabled, at least one secondary chilled water pump shall be enabled to run continuously. Whenever the system is disabled, the secondary pumps shall be disabled after a 1 minute delay.

e. Freeze Mode: The secondary chilled water system shall be enabled for freeze protection whenever:

1) The OAT falls below 25°F (adj.)

2) OR, any AHU (or other unit) is tripped off due to a freeze condition (auto or manual reset).

3) This mode shall not cause the primary system to operate (i.e. chiller(s) are not enabled).

f. Proof: BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead pump, the BAS shall enable the standby/lag pump and enunciate an alarm. The BAS shall rotate the lead pump on a regular basis (every 7 days – adj.) to equalize runtime.

g. VSD Control: Whenever a pump is energized and status is proven for at least one of the pumps, the BAS shall control the speed of the VSD to maintain the (lowest) differential pressure reading at setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.

h. VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.

i. Differential Pressure Setpoint:

- 1) Setpoint shall be initially set at 15psi (adj.).
- 2) Setpoint shall be adjusted by the TAB contractor for optimized building and energy performance.

j. Primary CHW Pump

- 1) The primary pump shall be started via an output from the chiller controller whenever the associated chiller is enabled.
- 2) BAS shall monitor the pump status.

k. Chiller Control

- 1) Enable/Disable: Whenever the Chilled Water System is enabled, AND Either Secondary pump is proven the Chiller shall be enabled after a 1 minute delay (adj.).
- 2) Proof/ Failure assessment: Whenever the chiller is in alarm, the BAS shall enunciate an alarm. BAS shall assess the chiller to be in alarm if:
 - (a) chiller status is not proven ON in the first 10 minutes after the chiller is initially enabled.
 - (b) OR, any time the chiller alarm point is ON.

7. CONDENSING BOILER HW SYSTEM –PRIMARY / SECONDARY

- a. General: BAS shall control the heating hot water system and equipment and provide monitoring and diagnostic information for management purposes. Boilers shall be interfaced such that loss of power from lead boiler will not cause operational issues for lag boiler.
- b. System Enable: System shall be enabled whenever
 - 1) manually selected to run by a manual command on the BAS
 - 2) OR, the System Override Timer (local twist timer switch) is enabled
 - 3) OR, the Outside Air Temperature is less than 50°F
 - 4) OR, there is a call for the Heating System to run from any AHU or terminal unit for 10 minutes

- 5) OR, any AHU (or other unit) is tripped due to a freeze condition (auto or manual reset).
 - 6) AND, the Emergency Stop Button is not enabled
 - 7) AND, the system is not manually disabled by a command on the BAS.
- c. System Disable: System shall be disabled whenever
- 1) the system is manually disabled by a command on the BAS
 - 2) OR, the Emergency Stop Button is enabled
 - 3) OR, the Outside Air Temperature is less than 50°F AND there is no call for the Heating System to run from any AHU or terminal unit for 5 minutes
- d. Secondary Pump Control
- 1) Start/Stop: Whenever the system is enabled, at least one secondary hot water pump shall be enabled to run continuously.
 - 2) Proof: BAS shall prove pump operation and use the status indication to accumulate runtime. Upon failure of the lead pump, the BAS shall enable the standby pump and enunciate an alarm. The BAS shall rotate the lead pump on a weekly basis (adjustable) to equalize runtime.
 - 3) VSD Control: Whenever a pump is energized and status is proven for at least one of the pumps, the BAS shall control the speed of the VSD to maintain the differential pressure at setpoint. On start and stop, the VSD shall ramp to speed and slow down within adjustable acceleration and deceleration limits.
 - 4) VSD Interface: BAS shall monitor the VSD via a direct interface. All available information shall be accessible via the interface for display on the VFD graphic. The VFD Alarm point shall be displayed on the main graphic and shall be alarmed via the BAS. All other points may be displayed on a separate graphic that is selected from this system's graphic. Reference the VFD chart on the project plans for additional information on points that should be hardwired versus integrated through a direct interface.
 - 5) Differential Pressure Setpoint:

(a) Setpoint shall be initially set at 15psi (adj.).

(b) Setpoint shall be adjusted by the TAB contractor for optimized building and energy performance.

e. Primary System Control

- 1) Enable/Disable: Whenever a primary system is requested by the BAS, the associated primary pump shall be enabled. When a primary system is disabled, the associated primary pump shall continue to run (for boiler pump down) for 2 minutes (adj).
- 2) Proof: BAS shall prove pump operation. Upon failure of the pump, the BAS shall enunciate an alarm and assess the pump as failed. The boiler controller shall then swap the lead primary system (as described above.) Alarm Management Proof/Failure Assessment: BAS shall assess the boiler as failed, any time the boiler alarm contacts are ON. Upon failure of the Boiler, the BAS shall enunciate an alarm at the BAS.
- 3) Secondary Hot Water Supply Temperature Setpoint: The BAS shall reset the secondary hot water supply temperature setpoint. The HW Supply Temperature setpoint shall be reset from 130°F to 160°F as the outside air temperature drops from 60°F to 40°F (all values being adjustable)

8. EXHAUST FAN OPERATION

a. Welding Lab and Toilet Exhaust Fans

- 1) The BAS shall schedule the on/off operation of exhaust fans.
- 2) Should a fan fail to start based on current sensor input an alarm shall be generated.
- 3) Should any AHU return to occupied operation via override the exhaust fan in that area shall be indexed on.

b. Mechanical Room Exhaust Fans

- 1) Fan shall be controlled by local thermostat.

9. MISCELLANOUS POINTS

- a. BAS shall monitor operation of air compressor.
- b. BAS shall monitor line pressure of compressed air, argon and argon mix.
- c. BAS shall monitor gas, electric and water usage.

END OF 230993

SECTION 231000 – PIPE AND PIPE FITTINGS

A. GENERAL

1. This section includes all pipe, pipe fittings, hangers, and supports, etc. as may be required to provide a complete piping system.
2. 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. Covered pipe shall be exposed at contracts expense. Engineer shall be given 48 hours written notification of test.
3. The actual arrangement of the piping shall follow the general locations shown on the Drawings, such that clearances, line drainage, etc. shall be maintained.
4. Refer to specification Section 230523 for Valving.
5. Refer to specification Section 232116 for Piping Specialties.
6. Refer to specification Section 230529 for Hangers and Supports.
7. Refer to specification Section 230700 for Pipe Insulation.
8. All piping shall be provided with end caps or have ends covered prior to installation.

B. PRODUCT

1. Hot and Chilled Water Piping
 - a) Piping shall be standard weight, Schedule 40, black steel pipe conforming to ASTM A-53.
 - b) Standard weight welding fittings shall be used and shall conform to ASTM A-234.
 - c) Screwed fittings shall be malleable iron, 150 lb. S.W.P., with banded pattern conforming to ANSI B16.3.
 - d) All chilled water piping shall be painted with two coats of rustoleum paint before insulating the pipe.
 - e) All hydronic-piping systems shall be hydrostatically tested at 150 psi for a period of not less than four (4) hours without loss of pressure. Any leaks that occur shall be repaired and another test started.
 - f) Chilled water piping shall not be placed in operation prior to insulating.
2. Low Pressure Steam and Condensate Piping
 - a) All steam piping above six (6) inches shall be seamless or welded carbon steel of Schedule 40 class, and meeting ASTM Specifications A-53, Grade B.
 - b) All steam piping six (6) inches and less shall be lap or butt welded of Schedule 40 class, and meeting ASTM Specifications ASTM 120.

- c) All condensate piping shall be lap or butt-welded of Schedule 80 class, and meeting ASTM Specifications A-53, Grade B, for six inches and over, and A-120 for Grade B for less than six inches.
 - d) Fittings large than two (2) inches shall be seamless steel weld fittings having a wall thickness not less than the adjacent pipe. Fittings shall conform to ASTM A-234, Grade B.
 - e) Fittings two (2) inches and smaller shall be cast iron screwed, 125 lb. and meeting ASA Specification ASAB16.4.
 - f) All steam and condensate piping systems shall be hydrostatically tested at a pressure equal to 1.5 times the operating pressure, for a period of not less than four (4) hours without loss of pressure. Any leaks that occur shall be repaired and another test started.
3. Refrigerant Piping
- a) Refrigerant piping shall be Type “L” hard drawn copper.
 - b) Refrigerant piping fittings shall be sweat type wrought copper.
 - c) Use silver solder on all refrigerant piping.
 - d) Copper tubing, which is out of round, will not be acceptable.
 - e) Not notching or mitering of copper tubing will be permitted.
 - f) Do not allow piping to rub against masonry when expanding and contracting.
 - g) Close and protect open ends of piping until final connections are made. Such closing shall be made with fittings, which cannot be easily removed. Caps or plugs shall be made with fittings, which cannot be easily removed. Caps or plugs shall be required at all times during construction so that no pipes are left open at the end of any day’s work, even though continuation is expected the next day.
 - h) Copper pipe ends shall be reamed, sanded and deburred before soldering. Non-corrosive flux shall be used.
 - i) Test refrigerant piping in accordance with the NC Building Code.
4. Make-up Water Piping
- a) Make-up water piping shall be Type “L” copper with all joints soldered with 95-5 solder.
 - b) Make-up piping shall have dielectric union at connection to ferrous pipe.
5. Condensate Drain Pipe
- a) Drain pan condensate piping shall be Type “L” copper with all joints soldered with 95-5 solder.
 - b) Terminate condensate drain lines as shown on drawings. Condensate drains from rooftop units are to be routed to nearest roof drain.
6. Gas Piping

- a) Piping below grade shall be polyethylene having a cell classification of ASTM D-3350-PE234343E. Pipe and pipefittings shall meet the requirements of ASTM D-2513. All fittings and access shall be as manufactured and furnished by the pipe supplier.
- b) Piping above grade shall be standard weight, schedule 40, black steel pipe conforming to ANSI B36.10, ASTM A53, or ASTM 106. Screwed fitting shall be malleable iron, 150 lb. S.W.P, will banded pattern conforming to ANSI B16.3.
- c) Connections between plastic and metallic piping shall be in accordance with the State Code.
- d) All pipes shall be buried in accordance with manufacturer's recommendations.
- e) All plastic pipe shall have a 3" wide detector tape installed 18" above finished grade.
- f) All metal pipe run below grade shall be coated with coal tar enamel coating.
- g) All exposed gas piping surfaces, supports, etc., shall be painted one prime and one finish coat of rust resistant paint. Finish coat shall be yellow according to OSHA Standards unless otherwise noted on the plans.
- h) All gas piping systems shall be tested in strict accordance with the National Fire Protection Association's National Fuel Gas Code NFPA54, and the State Building Code.
- i) All gas piping system shall be air tested at 50 psi for a period of not less than one (1) hour without loss of pressure. Any leaks that occur shall be repaired and another test started. All joints shall be checked for leaks with a water-soap solution. Where leaks are found, the joint shall be re-made.

7. Oil Piping

- a) Oil piping above grad shall be Tube "L" hard copper complete with oil filter and cut-off valve.
- b) Oil filter shall be mounted with sufficient service access below for filter removal.
- c) Oil piping below grade shall be Type "K" soft copper.
- d) All joints shall be soldered or brazed using solder with am melting point of 1000°F minimum.

8. Preinsulated Underground Hot and Chilled Water Piping

- a) Furnish a complete HDPE jacketed system of factory preinsulated steel piping for the specified service. All preinsulated pipe, fittings, insulating materials, and technical support shall be provided by the Preinsulated Piping System manufacturer.
- b) The system shall be FERRO-THERM as manufactured by Thermacor Process, L.P., of Fort Worth, Texas, XTRO-THERM by Perma-Pipe or prior approved equal.

- c) Carrier pipe shall be steel ASTM A-53, Grade B., ERW (Type E) or seamless (Type S), standard weight for sizes 2" and larger, and shall be ASTM A-106/A-53, seamless, standard weight for sizes 1-1/2" and smaller (Std. Wt. is the same as Sch. 40 through 10"). All carbon steel pipe shall have ends cut square and beveled for butt-welding. Straight sections of factory insulated pipe shall have 6" of exposed pipe at each end for field joint fabrication.
- d) Insulation shall be polyurethane foam either spray applied or high pressure injected with one shot into the annular space between carrier pipe and jacket. Insulation shall be rigid, 90-95% closed cell polyurethane with a 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K- Factor) of 0.14 and shall conform to ASTM C-591. Maximum operating temperature shall not exceed 250°F. Insulation thickness shall be specified by calling out appropriate carrier pipe and jacket size combinations as listed on drawing FTSG 7.108.
- e) Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 125 mils for jacket sizes less than or equal to 12", 150 mils for jacket sizes larger than 12" to 24", and 175 mils for jacket sizes greater than 24".
- f) Moisture barrier end seals shall be factory applied, sealed to the jacket and carrier pipe. End seals shall be certified as having passed a 20-foot head pressure test. End seals shall be high temperature mastic completely sealing the exposed end of the insulation. Field applied end seals shall be installed at any field cut to the piping before continuing with the installation.
- g) Straight run joints shall be field-insulated per the manufacturer's instructions, using polyurethane foam poured in an HDPE sleeve and sealed with a heat shrink sleeve. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketing materials shall be furnished by manufacturer.
- h) Fittings are shall be by same manufacturer and factory prefabricated and preinsulated fittings with polyurethane foam to the thickness specified and jacketed with a one piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket. Carrier pipe fittings shall be butt-welded, except sizes smaller than 2" shall be socket-welded. Fittings include expansion loops, elbows, tees, reducers and anchors. Elbows, loops, offsets, or any other direction changes shall conform to the standards set by ASME B31.1, Code for Power Piping.
- i) Expansion/contraction compensation will be accomplished utilizing factory prefabricated and preinsulated expansion elbows, Z-bends, expansion loops and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2".

- j) Prefabricated systems shall be provided as SC (standard components) fittings and factory insulated straight pipe sections for field engineering per the contract drawings.
- k) Underground systems shall be buried in a trench not less than two (2) feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.
- l) Trench bottom shall have a minimum of 6" of sand, pea gravel, or specified backfill material as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer's installation instructions.
- m) A hydrostatic pressure test of the carrier pipe shall be performed. The system shall hold 100 psi for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test.

C. EXECUTION

1. Piping 2" and smaller shall be welded or have screwed fittings with extra heavy nipples, unless otherwise noted.
2. Piping 2 1/2" and larger shall have welded fittings of the same material and weight as the piping in which they are installed.
3. Welding tees or weldolets shall be used.
4. No "Stub-In" shall be permitted.
5. All insulated piping shall be protected by saddles at horizontal support points or by insulation protectors if the insulation has a vapor barrier. Saddles where used shall be welded to the pipe.
6. Sleeves shall be provided wherever pipes pass through walls, floors and ceilings. Sleeves shall be Schedule 40, black steel, 1/2" in diameter larger than the pipe and insulation on the pipe. Sleeves through walls and ceilings shall be flush. Sleeve through floors shall extend two inches above finished floor. Sleeves in exterior walls shall be caulked and made watertight.
7. All pipe welding shall be uniform and thorough, and shall comply with AWS standards for pipe weldings. All pipe welding must be done by AWS certified welders experienced in this type of work. Provide copy of certification with other credentials to Engineer with piping submittal package.

END OF SECTION 232113

SECTION 231116 – PIPING SPECIALTIES (HYDRONIC)

A. GENERAL

1. This Section includes miscellaneous items required for a complete hydronic piping system.

B. PRODUCT

1. Unions
 - a. Unions two inches and smaller shall be rated at 150 lb. S.W.P.
 - b. Unions 2-1/2" and larger shall be gasketed flanged connections.
 - c. Unions shall be ground joint with brass to iron seat.
 - d. Gasket material shall be 1/16" compressed fiber gasket or approved equivalent.
 - e. Flanged unions shall have welding ends.
2. Reducers
 - a. Eccentric reducers shall be used on all water lines with top of the reducer level.
 - b. Concentric reducers shall be used wherever equipment connections do not conform to pipe sizes.
3. Strainers
 - a. Strainers 2" and under shall be screwed; 2-1/2" and larger shall be flanged.
 - b. Strainers shall be "Y" Type with 1/10" Monel mesh screens.
 - c. Strainer shall be rated for 125 lb. S.W.P.
 - d. Each strainer shall be equipped with a short nipple and ball valve with hose bibb adapter and chained caps.
 - e. Strainers shall be Hoffman, Sarco, Crane or approved equivalent.
4. Escutcheons
 - a. Escutcheons shall be provided wherever pipes pass through walls, floors, or ceilings.
 - b. Escutcheons shall be of sufficient size to cover insulation where applicable.
 - c. Escutcheons shall be split ring, cast brass, chromium plated type.
 - d. Escutcheons shall be designed to cover pipe sleeve projection.
 - e. Escutcheons shall be Ritter, Crane or approved equivalent.
5. Thermometers
 - a. Light Activated Thermometers: 6-inch plastic case with adjustable angle; LED digital display; aluminum stem of length suitable for application for thermowell installation; 1- 1/4 inch connector with ASME B1.1 screw threads; and accuracy to plus or minus 1 deg C.
6. Pressure Gauges
 - a. Gauges shall be all glycerin filled, stainless steel construction with bottom 1/4" inch stem mount.
 - b. Gauges shall be ASME B40.1, Grade A- 1% accuracy.

- c. Operating pressure shall be between 25-60% of gauge range.
 - d. Gauges shall have 3 ½ -4" dial size.
 - e. Gauges shall be Marshalltown, Marsh or approved equivalent.
 - f. Gauges are to be installed where they are easily visible from floor level.
7. Air Vents
- a. Provide where shown and wherever air traps might occur in the piping system.
 - b. All down feed water risers shall have air vents.
 - c. All vents shall be manual, coin-operated type.
 - d. Provide access to all air vents.
 - e. Air vents shall be B & G or approved equal.
8. Air Separators
- a. Air separator shall have tangential inlet and outlet connections, blowdown connections, internal perforated stainless steel air collector tube, internal perforated galvanized water strainer and manual air vent.
 - b. Water strainer shall have 3/16" perforations and a free area of not less than 5 times the cross sectional area of the connecting pipe.
 - c. Unit shall be ASME and National Board stamped for 125 PSIG working pressure.
 - d. Heating and Air Conditioning Contractor shall provide piping from air separator's blowdown connection to nearest floor drain.
9. Expansion Tanks
- a. Expansion tanks shall be shell and bladder type.
 - b. Shell shall be fabricated steel designed and constructed per ASME Section VIII for 125 pound working pressure.
 - c. Bladder shall be heavy-duty butyl rubber removable for inspection.
 - d. The tank shall be as manufactured by Bell and Gossett, Armstrong, or Taco.

END OF SECTION 232116

SECTION 232123 - PUMPS

A. GENERAL

1. Furnish and install pumps with capacities as shown on the plans.
2. All pumps shall be by the same manufacturer.

B. PRODUCT

1. Base-mounted pumps shall be:
 - a. Bell & Gossett 1510 and 80 Series
 - b. Taco FM Series
 - c. Armstrong 4030 Series
2. Inline pumps shall be:
 - a. Bell & Gossett 60 or 80 Series
 - b. Taco 1600 or KV Series
 - c. Armstrong 1000 or 4300 Series
3. Pumps shall have cast iron casing, bronze impeller, vertical split casing (base-mounted pumps), bronze renewable shaft sleeve and mechanical seals for service intended.
4. Pump and motors shall be furnished with grease lubricated bronze ball bearing with bearing protection, and bearing assemblies shall be interchangeable in several size pumps.
5. Bearing assembly with seal and impeller shall be removable without disturbing pipe connections. The base-mounted pumps shall be foot supported with spacer coupling for back pull-out.
6. Base-mounted pumps shall be mounted on structural steel sub-base.
7. Pump suction and discharge connections shall be tapped for pressure gauges.
8. Pump and seal shall have 175 PSI working pressure.
9. Pump and motor shall be designed, selected, built and guaranteed for quiet operation.
10. All pumps shall be sized to be fully non-overloading throughout the complete curve of the selected impeller, and nameplate motor horsepower.
11. All pumps shall be supplied with triple duty valves. Base-mounted pumps shall be supplied with suction diffusers and flexible connections.
12. Base-mounted pumps frames shall be grouted per manufacturer instructions.
13. Pumps with VFD shall be provided with grounding rings.

C. EXECUTION

1. The Contractor shall submit to the Engineer submittal data on all pumps, i.e., performance curves indicating capacity, head, impeller diameter, horsepower efficiency, suction and discharge sizes.

2. The Contractor is to insure that pump nameplate data includes manufacturer's name, pump model number, pump serial number, capacity, head, horsepower, RPM and voltage.
3. The contractor shall provide (1) set of spare seals for each pump, turned over to the owner for storage.
4. See 230553 for identification of equipment.

END OF SECTION 232123

SECTION 232923 – VARIABLE FREQUENCY DRIVES

A. GENERAL

1. DESCRIPTION

- A. This section describes variable-frequency AC drives (VFDs) for HVAC equipment.

2. RELATED WORK SPECIFIED ELSEWHERE

- A. Section 230500, Common Work Results for HVAC
- B. Section 230900, Instrumentation and Controls for HVAC
- C. Division 26, Electrical

3. REFERENCES

- A. IEEE: Institute of Electrical and Electronics Engineers
 - 1. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- B. NEC: National Electrical Code
- C. NEMA: National Electrical Manufacturers Association

4. SUBMITTALS

- A. For systems, equipment, and components specified herein, submit product/material data; shop drawings; operation and maintenance data; as-constructed data; installation, startup, and testing manuals; operation and maintenance manuals; and as-constructed drawings.
 - 1. Product Data: Include dimensions, weight, schematic and single-line diagram, total harmonic distortion (THD), standard functions, features, capacities, and details of construction.

5. WARRANTY

- A. VFDs shall have a minimum warranty of 12 months from the date of certified startup and not less than 18 months from date of manufacture. The warranty shall include all parts, labor, travel time, and expenses.

- B. The Contractor shall coordinate with the VFD manufacturer and be responsible for the VFD warranty and all VFD problems incurred during and after installation at the work site, as well as provide and warranty any individual VFD units sent to the manufacturer for required equipment run testing. Supply technical assistance during testing at the manufacturer's factory, coordinate shipping, and pay for all costs.

B. PRODUCTS

1. VARIABLE-FREQUENCY MOTOR CONTROLLERS

- A. Acceptable Manufacturers: ABB, Honeywell or Trane

- B. General Description:

1. AC motor variable frequency controller (VFC) shall be of pulse width modulated (PWM) inverter type. The VFC shall be designed to convert 60 Hz input power to adjustable frequency output power to provide positive speed control to standard induction motors. The VFC shall be dedicated variable torque design for specific use with centrifugal loads.
2. Provide complete solid state variable frequency power and logic unit.
3. Frequency control shall be stepless throughout the range under variable torque load on a continuous basis. Frequency controlled by remote building energy management system providing 4-20MA input signal to drive and remote start/stop signal. Coordinate with other work of Division 23.
4. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.
5. Each VFD shall contribute no more than 5 percent total harmonic voltage distortion at the VFD input terminals while operating under full-load conditions. If proposed VFD equipment is anticipated to exceed these limits, multi-pulse converters and/or harmonic filtering devices shall be provided.
6. Design and manufacture equipment in accordance with applicable NEMA and IEEE recommendations and be designed for installation in accordance with NEC. Equipment shall have UL and/or CSA approval.
7. Control shall be suitable for operation in ambient temperatures of 0 to 40°C.
8. Every VFD shall be factory tested with an AC induction motor 100 percent loaded and temperature cycled within an environmental chamber at 104°F.

- C. Self-Protection and Reliability Features:

1. Adjustable current limit from 60 to 110 percent of drive rating.
2. Adjustable instantaneous over current trip.
3. Under voltage trip.
4. Over temperature trip.
5. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive.

6. Momentary power loss, more than 17 milliseconds.
7. Transient protection against all normal transients and surges in incoming power line.
8. Orderly shutdown in event of any of above conditions, drive shall be designed to shut down safely without component failure.
9. Provide visual indication and manual reset.

D. Standard Features:

1. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry.
2. Standalone operation to facilitate startup and troubleshooting procedures.
3. VFD shall have a lockable circuit breaker disconnect and be UL 508C listed for use on distribution systems with 22,000 AIC.
4. Door interlock protection which shall be defeatable by qualified personnel to troubleshoot during operation as required.
5. Input power shall be equal to applied input voltage.
6. Isolated signal inputs.
7. Frequency Stability: Output frequency shall be held to +0.1 percent of maximum frequency regardless of load, +10 percent input voltage change or temperature changes within ambient specification.
8. Built-in digital display located in panel face shall indicate output frequency, voltage and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, and fault condition.
9. Start/Stop Control: Controlled decelerated stop.
10. Primary and secondary fused for a control circuit transformer.
11. Minimum and maximum speed control.
12. Adjustable Accel/Decel: Independently adjustable 10-100 second.
13. Hands-off auto switches.
14. Programmable auto restart after power outage.
15. Fused disconnects shall include auxiliary contacts to isolate control circuit when disconnect is in "off" position.
16. Remote contacts for fault, and on/off status.
17. Adjustable motor output voltage.
18. Analog output voltage of 0-10 VDC, 4-20MA proportional to control output frequency.
19. Communications port, and programming software capability for BACnet-IP

E. Additional Features:

1. NEMA 1 enclosure shall isolate each motor starter and control section with its associated disconnect switch.
2. Manual speed control for each motor.
3. Manual bypass shall provide ability to service control while motor is operational.
4. Provide radio frequency and electromagnetic interference noise suppression network to limit radio frequency and electromagnetic interference.

5. Provide isolated analog output signals for volts, amps, and frequency, from each VFD for connection to the building energy management system.
6. Provide with line (input) reactors with no less than 3% impedance.
7. Provide output filters for all VFD's located more than 150 conductor feet from the motor they serve.
8. VFD shall be designed to catch a spinning load in forward and reverse direction.
9. Perform harmonic calculations on a manufacturer-supplied harmonic analysis program for conformance with IEEE 519.
10. Drive shall be CSA, ETL, or UL label and listed.

C. EXECUTION

1. GENERAL

- A. Coordinate with the VFD manufacturer to provide and be responsible for all coordination, application engineering, and startup support to ensure that the VFD is properly selected for each piece of equipment.
- B. Where required by the variable frequency drive manufacturer, coordinate provision of VFD (variable frequency drive) cable by the mechanical (Division 23) contractor for all VFD driven equipment where such cabling between the output of each VFD and driven equipment shall consist of 3-phase, 3 ground, copper tape spiral shield, galvanized steel interlocked armor cable.

2. VARIABLE SPEED CONTROLLER INSTALLATION

- A. Mount on walls in accordance with the manufacturer's instructions.
- B. Coordinate input/output power connections with Division 26.
- C. Coordinate control signal with other work of Division 23.
- D. Provide startup service by factory authorized technician.

3. TESTING

- A. Check out, start up, and test systems, equipment, and components specified herein.
- B. The owner reserves the right to witness any or all of the aforementioned tests. Provide notice at least 24 hours before testing.
- C. Provide, at no additional cost to the owner, any technical assistance or support to ensure the proper testing/performance of the VFD and of the system as a whole. This includes

programming of the VFD to coordinate with the manufacturer's operating requirements. Allow 2 hours of startup time per VFD.

- D. Provide complete programming information for startup for each VFD. Provide these parameters in writing to the owner prior to the startup of the VFD and cover the protection, ramp up, ramp down, carrier frequency, and all other necessary parameters.

END OF SECTION 232923

SECTION 233100 – DUCTWORK

A. GENERAL

1. This Section includes ductwork, splitter dampers, balancing dampers, air deflection devices, etc. required for a complete system.
2. The Drawings are intended to indicate, with reasonable accuracy, the location of components and the general arrangement of the system. All offsets, bends fittings and other devices, not shown but required for the full operation of the system, shall be provided.
3. Refer to specification Section 230700 for duct insulation.

B. PRODUCT

1. Low and Medium Pressure Ductwork.
 - a) Round and rectangular ductwork shall be of gauges and construction methods as indicated in the latest ASHRAE Guide and SMACNA Standard.
 - b) Splitter dampers, balancing dampers, turning vanes and air deflection devices shall be installed as shown on the plans and/or where required for the proper control of airflow.
 - c) All take-offs to diffusers shall be tapered type taps with factory damper and locking quadrant.
 - d) All take-offs to VAV Units shall be made with conical taps.
2. Flexible Ductwork
 - a) Ducts shall be insulated type with foil wrapper complying with NFPA Standard No. 90A and UL181.
 - b) All flexible ducts shall have a factory installed 1" thick 1.5 lb./cu. ft. fiberglass insulation with a seamless vinyl vapor barrier.
 - c) Length of flexible duct shall not exceed 10 feet.
 - d) Flexible duct shall be secured and sealed in place with mastic to hard duct collars at each end, with nylon tie-wraps on the wire enforced inner mylar skin, followed by the insulation layer and then the exterior vapor layer secured with another tie-wrap.
3. Exposed Ductwork
 - a) Exposed shall be round, 18 gauge spiral lock seam with paintable finish, double wall and internally insulated at the factory. Inner wall shall be perforated.
 - b) Duct shall be fastened using sheet metal screws only and no duct tape.
4. Kitchen Hood Ductwork
 - a) Kitchen hood exhaust ductwork shall be welded 16 gauge black steel conforming to NFPA 96.

- b) This contractor shall supply all necessary welded 16 gauge black steel fittings for transitions to the hood and exhaust fan.
 - c) Ductwork shall be provided with a slope in accordance with the State Building. Cleanouts are to be provided at each change of direction.
 - d) Kitchen hood supply ductwork shall be galvanized sheet metal as specified for low-pressure ductwork.
5. Dishwasher Hood Ductwork
- a) Dishwasher hood exhaust ductwork and dishwasher area exhaust ductwork shall be welded seam and joint type 302 stainless steel. All joints shall be welded watertight.
 - b) Ductwork shall be provided with a slope towards the dishwasher intake hood.
6. Dryer Ductwork.
- a) Dryer ductwork shall be round 30 gauge-galvanized steel with substantially airtight joints and shall connect to box outlet.
 - b) Sheet metal screws shall not be used at joint connections.
 - c) Joints shall run in direction of airflow.

C. EXECUTION

1. Turning vanes shall be installed in square elbows for all ductwork.
2. Duct transitions, splitter dampers, and balancing dampers shall be constructed of gauges and materials as indicated in ASHRAE Guide and SMACNA Standards.
3. Hangers and supports for ductwork shall be of metal bands, angles and rods as indicated in ASHRAE Guide and SMACNA Standards. The minimum bandwidth shall be 1", 16 gauge, galvanized steel.
4. Where ductwork passes through floors and walls, the space around the ducts shall be sealed in an approved manner with mineral wool insulation, and/or proper fire seal material approved by the State or Local Inspector.
5. In exposed areas and mechanical rooms, ductwork openings shall be finished with a metal collar.
6. Ductwork shall be cross-braced and reinforced properly with galvanized steel angles as recommended by SMACNA Standards.
7. Where ductwork behind grilles or diffusers is visible, it shall be painted with two coats of flat black base fire retardant paint.
8. Duct connections to outside air louvers shall be pitched to drain outside and shall be soldered watertight.
9. Tape all low-pressure joints with Hardcast or approved equal for completely airtight system.
10. All medium pressure joints are to be sealed in accordance with SMACNA standards for ductwork 2" W.C. and greater. All ducts shall be air tight, rigid and free from vibration and noise.

11. Duct dimensions shown on the drawings are net inside dimensions.
12. Where ductwork is lined, as noted in Section 230700, the duct insulation thickness shall be added to the listed ductwork dimensions for final duct size.

END OF SECTION 233100

SECTION 233400 – FANS

A. GENERAL

1. Provide all fans, roof caps, etc., of the type and capacities indicated on the Drawings.
2. Fans, roof caps, curbs, etc., shall be by the same manufacturer.
3. Fans shall be by Greenheck, Loren Cook, Carnes, Penn, American Air Cool, or equal.

B. PRODUCT

1. All fans, roof caps, etc., shall be as scheduled on the Drawings.
2. All fans shall be equipped with 1/2" mesh birdscreen, gravity damper.
3. All fan motors shall have vibration isolators, motor housing shall be grounded, and motor overload protection shall be provided.
4. All curbs shall be of the pre-fab insulated type.
5. Provide NEMA 3R rated disconnect switch.

C. EXECUTION

1. Fans and roof caps shall be installed as shown on the plans.
2. Wall openings and locations are to be coordinated with the other trades.
3. Fan motors and all other electric components shall bear the UL or other acceptable third party testing agency label.

END OF SECTION 233400

SECTION 233600 – AIR TERMINAL UNITS

A. GENERAL

1. The contractor shall provide air terminal units where shown on the plans.
2. Units shall be selected as scheduled on the plans.
3. Units shall be by Price, Nailor, Carrier, Trane, Metalaire, Reddi, or Titus.
4. Air terminal units shall be tested and certified in accordance with ARI Standard 880.

B. PRODUCT

1. VAV Terminal Unit
 - a. The unit casing shall be of 24-gauge zinc coated steel, acoustically lined with ¾” thick, 1-1/2 pound density fiberglass and shall comply with UL 181 and NFPA 90A.
 - b. The reversible actuator shall be shaft mounted without linkage and shall be an integral part of the electronic controller.
 - c. Units shall have pressure independent electronic control and shall be reset for air flow between zero and the maximum cataloged cfm.
 - d. The damper shall be double thickness of 24-gauge steel, with shaft rotating in self-lubricating bearing.
 - e. Dampers shall be designed such as to prevent air leakage in excess of 1% of the rated quantity at rated inlet static pressure.
2. Fan Terminal Unit
 - a. The unit casing shall be of 20-gauge zinc coated steel, acoustically lined with 1” thick, 1 ½ pound density fiberglass and shall comply with UL 181 and NFPA 90A.
 - b. Unit fans shall be forward curve centrifugal type with direct drive, three speed, permanently lubricated split capacitor type motors.
 - c. Unit shall have factory-installed volume control dampers. Dampers shall be designed such as to prevent air leakage in excess of 1% of the rated air quantity at rated inlet static pressure.
 - d. Terminal unit fan shall be controlled by means of an electronic speed controller with voltage limiting circuit and shall turn on whenever heating is required even though primary air system is turned off.
 - e. Provide with 1” filter rack on the fan air inlet.
3. Electric Heat
 - a. Fan controls to be provided with a fan interlock relay.
 - b. Provide with an air static switch to prove airflow.
4. Hot Water Coils

- a. Coils are to be 2-row, constructed of aluminum fin and copper serpentine-type tubes with sweat connections tested at 250 psig.

C. EXECUTION

1. The units shall be installed where shown on the plans.
2. All units shall be installed according to manufacturer's recommendations.
3. Suspend units from spring and rubber vibration isolation hangers.
4. Provide flexible connections at ductwork and piping.
5. All electrical components shall be UL recognized and installed in accordance with the NEC.
6. Refer to drawings for controls.
7. Actuators shall be supplied by controls contractor and mounted at the factory.

END OF SECTION 233600

SECTION 233700 – AIR DISTRIBUTION

A. GENERAL

1. Furnish and install air distribution devices of the type, size and configuration indicated on the drawings.
2. Refer to Architectural Reflected Ceiling Plan and Schedule for types of ceiling specified, and provide compatible frames on air distributions devices.

B. PRODUCT

1. Diffusers, Grilles, and Registers
 - a) Surface mounted devices shall have sponge gaskets.
 - b) Devices shall be of steel construction with baked on enamel finish, unless otherwise noted.
 - c) All devices shall be by Kureger, Carnes, Titus, Metalaire, Tuttle & Bailey, Price or approved equivalent.
 - d) Ceiling mounted diffusers shall have insulation applied to metal top and neck to prevent sweating. Insulation shall match duct insulation.
 - e) Soffit grilles shall be extruded anodized aluminum with ¼” x ¼” insect screen.
 - f) Return and exhaust grilles in lay-in ceilings shall have full louvered face (24” x 24”).
 - g) Devices in moist and humid spaces shall be of aluminum construction.
 - h) Provide heavy-duty steel return grilles (in gymnasiums, multi-purpose rooms, etc) or in all locations where the grille is within 8’ off the floor.
 - i) Lay-in diffusers installed 12 feet above finished floor shall have adjustable vanes for vertical throw.
 - j) Where grilles are installed above hard ceilings with no access to balancing dampers, opposed blade dampers shall be installed.
2. Louvers
 - a) Louvers shall be 12 gauge extruded aluminum with drainable blades, unless otherwise noted.
 - b) Louvers shall be provided with ½ ” x ½ ” insect screen.
 - c) Louvers shall be Arrow, Ruskin, Air Balance or approved equivalent.
 - d) Provide louvers with required mounting sleeves/support. Coordinate opening with general contractor.
 - d) Combination louver/dampers indicated on drawings to have motorized damper shall be interconnected with fans indicated, and shall open when the fan is energized. This Contractor shall provide and make all interconnecting control wiring from the fan to the damper.

C. EXECUTION

1. Air distribution devices shall be mounted level, straight, and flush with walls or ceilings.
2. Color shall be as indicated on drawings, or as selected by the Architect/Engineer.
3. Locations of all air distribution devices shall be coordinated with ceiling and lighting work.
4. Provide submittals data to include, cfm, pressure drop, dimensional, velocity and noise criteria data.

END OF SECTION 233700

SECTION 235116 – BOILER – CONDENSING STYLE

A. GENERAL

1. Summary: Section include:
 - a. Modulating, condensing boilers
 - b. Boiler management control system
 - c. Boiler venting material
2. Related Sections:
 - a. Section 230500: Basic Mechanical Requirements.
 - b. Section 231000: Hydronic and Gas Piping.
 - c. Section 232116: Hydronic Specialties.

B. PRODUCT DATA:

1. Submittals under provisions of Section 013000.
2. Submittals shall include the following as a minimum:
 - a. Boiler length, width, height, and weight.
 - b. Full and part load efficiency curves specific to the boiler model at lowest to highest firing rates and minimum to 200 deg F water temperature.
 - c. Operational description with Boiler Management System and integration with building energy management system.
 - d. Complete Gas train drawings showing components.
 - e. Venting system material of construction and UL listing. Vent system submittal must include boiler manufacturer's approval in writing of vent design and layout; and a scale CAD drawing showing components.
 - f. Drawing of Boiler System showing plan and elevation dimensions, piping locations, and major equipment if different from contract drawings. For boilers requiring primary dedicated piping with a secondary loop, revised piping details must be submitted for approval. The revised detail must insure maximum efficiency by allowing lowest system return water temperature to each boiler in a parallel fashion.
 - g. Submittals which are generic and not specifically designed to meet the requirements on this section shall not be acceptable.
 - h. Boiler warranty.
3. Operation and Maintenance Data:
 - a. Submit under provisions of Section 01700.
 - b. Maintenance Data: Include installation and calibration instructions, spare parts list, exploded assembly views.
4. Quality Assurance:

- a. Boiler Manufacturer: U.S. manufacturing Company specializing in the products specified in this section, modulating condensing boilers, with minimum five years documented experience.
 - b. Installer: Company specializing in performing the work section of this section with documented experience.
 - 1) Regulatory Requirements:
 - a. Conform to ASME B31.9 code for installation of piping system.
 - b. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.
5. Delivery, Storage, and handling:
- a. Deliver products to site under provisions of Section 01600.
 - b. Store, protect and handle products under provisions of Section 01600.
 - c. Comply with package manufacturer's instructions for rigging, unloading, and transporting equipment.
6. Warranty:
- a. The pressure vessel/heat exchanger, combustion chamber from burner to vent connection, and cabinet of the boiler shall carry a 5 year non-prorated, warranty against failure due to condensate corrosion and/or thermal stress, defective materials or workmanship. The Burner shall carry a ten-year non-prorated warranty. A Warranty Certificate must be issued to the owner from the manufacturer and a copy of warranty be submitted for engineers approval.
 - b. All other component parts shall carry a 1-year from startup/18 months from shipment warranty due to defects in manufacturing.
 - c. In addition to parts warranty, Boiler Manufacturer or representative shall provide labor warranty for 1 year from startup/18 months from shipment which ever comes first, for all boiler components. A full service just prior (no later than 18 months from start-up) to owner turnover shall be preformed as a part of this warranty. This service shall include all manufacturers' suggested maintenance with service parts included.
7. System Startup:
- a. Boiler manufacturer shall provide the services of a local factory authorized representative to supervise and perform all phases of equipment startup. Local authorized representative(s) shall be located within Wake County. Authorized representative shall be defined as having attended and completed an on site Factory school with class room and specific operating equipment training of no less than three days, and have assisted in at least two prior complete startups. Generalized boiler training does not qualify. A letter of compliance with authorized start-up and service representative qualifications plus all factory recommendations and installation instructions shall be submitted to the engineer with operation and maintenance instructions before

approval. After start-up and at final service, a flue gas combustion analysis shall be provided to the engineer and owner for approval that shows each boiler operating parameters and factory recommended conditions.

C. PRODUCTS:

1. Manufacturers:

- a. Aerco International (Benchmark and KC models), Lochinvar (Crest Models), and Fulton (Pulse) are considered manufactures of modulating, condensing boilers, provided this section is adhered to completely.
- b. Substitutions under provisions of Section 01600.

2. Manufactured Units:

- a. Furnish and install boiler plant as shown on plans and operation and maintenance manuals, with all applicable codes and authorities having local, state and federal jurisdiction.
- b. The boiler plant may consist of single or multiple hydronic boiler modules to meet requirements of this specification section. Each Boiler shall have the following as minimum requirements:
 - UL listed with label
 - FM (Factory Mutual) approved gas train
 - CSD-1 approved and stamped
 - ASME coded and stamped as "H"
- c. Each Boiler Module shall have an input of 1,000mBh to 2,000mBh with when fired with natural gas.
- d. The Boiler manufacturer MUST publish known part load value efficiencies for each boiler model; the efficiency must increase as the firing rate decreases. Minimum efficiency at full fire and 180 deg F return water temp shall be no less than 87%. Maximum efficiency must be at least 97% at low fire and minimum return water temperature.
- e. Electrical service to each boiler unit shall be as shown on the plans. Variations to the design shall be the responsibility of the mechanical contactor.
- f. Each boiler supplied must be installed with the necessary controls to operate individually, stand alone basis, in addition to operation with the manufacturers boiler plant management system. The individual boiler mounted control panel (not the boiler plant management panel) shall be of a modular component design with the boiler flame safeguard control, temperature controller and annunciator board field replaceable. The individual boiler control panel shall be provided with internal operating controls in all cases to allow full boiler operation and modulation independent of the boiler plant management panel in case of boiler management panel failure. Each individual boiler shall be provided with the capabilities of operating either with a local constant Setpoint control, a remote

signal (4-20 mA or similar) from the building BMS system for target temperature, and internal outdoor air reset control fully settable and adjustable for independent and remote boiler control. The individual boiler control panel shall display status, alarms, percent fire, and status as a minimum. Boilers requiring individual pumps (water tube design) must include pump time delay timers on each boiler to maximize operating efficiency.

- g. All Boilers shall be installed with a minimum of 24” between modules for adequate serviceability, plus other manufacturer recommended minimums. Zero side clearance is not acceptable to the owner.
- h. Boiler module system shall include AL-29-4C Stainless Steel Alloy category IV vent system UL listed for condensing boiler applications, shipped loose for field installation.

D. EQUIPMENT

1. Boiler modules shall be natural gas fired, condensing design with a modulating burner/gas train and positive pressure vent discharge. Boilers must be capable of dedicated ducted inlet combustion air.

2. MODULATING BURNER:

a. The multiple module boiler plant shall be capable of turndown ratios as follows:

<u>Total MBh input</u>	<u>Minimum acceptable turndown of boiler plant (Min fire rate, mBh)</u>	
1000	8:1	125
1500	8:1	188
2000	8:1	250
4000	12:1	333
6000	16:1	375

b. The Mechanical Contractor shall be entirely responsible for clean combustion air during the entire project. This includes changing combustion air filters if required, and full labor and parts warranty of any damage due to clogged burners due to dirty air conditions, expenses of any service problems as a result of combustion air quality problems, and damages to the building or construction delays as a result of boiler failure.

3. PRESSURE VESSEL/HEAT EXCHANGER:

a. The boiler plant shall be capable of handling return water temperatures down to 90 deg F without any failure due to thermal shock or fireside condensation. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.

b. All (primary or primary and secondary) heat exchanger tubes and related components such as baffles or tube sheets shall be constructed of 316L stainless

steel or CuNi. Copper tubes, carbon steel and other materials not rated for constant condensing flue gas exposures are not acceptable.

- c. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig.
- d. Boilers shall either be provided with carbon steel flange water connections or dielectric unions for copper connections.

4. EXHAUST MANIFOLD:

- a. The exhaust condensate handling system shall be installed according to manufacturers instructions.

5. BOILER CONTROLS:

- a. The boiler controls shall be Underwriters Laboratories Recognized and labeled.
- b. The combustion safeguard/flame monitoring system shall incorporate a UL recognized combustion safeguard system utilizing ignition control and a rectification type flame sensor. An electro-hydraulic double seated safety shutoff valve with proof of closure switch shall be an inherent part of the gas train on each boiler.
- c. Each boiler shall incorporate an electric type low water level cutoff with test and manual reset and dual over-temperature protection (with automatic and manual reset) in accordance with ASME section IV and CSD-1. Remote fault alarm contacts, sensor failure detection and boiler status and failure annunciator shall be standard equipment. For water tube boilers, a flow switch must also be provided.

6. TEMPERATURE CONTROL MODES

- a. The boiler plant shall be provided with a boiler management system to allow operation in all of the following control modes as standard and field selectable:
 - ___ 1. Internal Setpoint
 - ___ 2. Indoor/Outdoor Reset
 - ___ 3. Remote Temperature Setpoint
- b. Boiler Management System (BMS) - The Boiler Manufacturer shall supply as part of the boiler package a completely integrated Boiler Management System to control all operation and energy input of the multiple boiler heating plant. The BMS shall be comprised of a microprocessor based control utilizing an RS-485 or similar interface between the BMS and the Boilers. The single BMS controller shall have the ability to operate all boilers required utilizing pulse width modulation for bumpless control of header temperature. The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The BMS shall control the boiler outlet header temperature within $\pm 2^{\circ}\text{F}$. The controller shall be a PID type controller for accurate temperature control with excellent variable load response. The BMS controller shall provide contact closure for auxiliary boiler(s) for

combination plant designs should present or future needs require. The BMS controller shall have a LCD display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each module by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between central BMS system and individual modules shall be twisted pair low voltage wiring or similar, with the boilers 'daisy-chained' for ease of installation. BMS shall index multiple boiler modules on at low fire rates under low loads and ramp each boiler simultaneously together under low fire rate for energy efficiency optimization with custom sequencing.

- c. When set on Internal Setpoint Mode, temperature control setpoints on the BMS shall be fully field adjustable from 90°F to 200°F in operation.
- d. When set on internal Outdoor air reset mode, BMS shall be capable of resetting header temperature based on outside air temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation.
- e. The boiler plant will operate to vary header temperature setpoint linearly as an externally applied 4mA to 20mA signal (or similar) is supplied to the BMS. Main Header outlet temperature shall not be more than $\pm 2^{\circ}\text{F}$ from setpoint at any point of operation. The external signal will allow full remote control of boiler header temperature by the building management system. Control limitations of minimum or maximum boiler water temperatures will be the full responsibility of the boiler manufacturer. Remote monitoring of alarms shall be required.
- f. The Boiler Manufacturer must provide header and outdoor air sensors as required.
- g. BMS shall include a remote enable/disable feature for remote control by building management system. The BMS is to be configured to provide both local (stand alone) and remote control.
- h. The control of the boilers shall allow operation of second boiler even if the first boiler is powered off.

E. INSTALLATION:

1. All aspects of installation of Boiler Plant shall be in strict accordance with manufacturer's instructions.
2. The vent system must conform to all manufacturers' recommendations and shall utilize UL listed stainless steel AL-29-4C Positive Pressure. The vent must be sized in accordance with manufacture's recommendations.
3. Boiler plant piping shall be field constructed of materials as specified.
4. Each boiler shall have individually isolating shutoff valves for service and maintenance.

5. Each Boiler shall be provided with dedicated gas regulator as required according to proper operation and a gas supply shut off valve.
6. Each boiler must be supplied with spare parts (parts to be supplied for each boiler) to be turned over to the owner prior to start-up of the Boiler(s). These parts to include spare spark igniter or hot surface igniter, flame proving sensor, pump seals/bearings/couplings, four sets of cabinet gaskets with sealant, any special tools for service.
7. Provide plastic laminated labels for each boiler label as follows:
 - Boiler #1
 - Substantial Completion
 - Capacity_____MBH

END OF SECTION 235216

SECTION 236400 – CHILLER – AIR COOLED

A. GENERAL

1. SUMMARY

- a. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air-cooled rotary scroll packaged chillers.

2. REFERENCES

- a. AHRI 550/590 - Standard for Water Chilling Packages using the Vapor Compression Cycle
- b. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment
- c. ASHRAE 15 - Safety Code for Mechanical Refrigeration
- d. ASHRAE 90.1 -2010 - Energy Efficient Design of New Buildings
- e. UL 1995 - Central Cooling Air Conditioners
- f. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- g. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- h. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- i. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments
- j. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings.
- k. ISO 9001

3. SUBMITTALS

- a. Submit dimensional plan and elevation view drawings, weights and loadings, required clearances, location and size of all field connections, electrical requirements and wiring diagrams.
- b. Submit product data indicating rated capacities, accessories and any special data.

- c. Submit manufacturer's installation instructions.
- 4. REGULATORY REQUIREMENTS
 - a. Comply with codes and standards specified.
 - b. Chiller must be built in an ISO 9001 classified facility.
- 5. VERIFICATION OF CAPACITY AND EFFICIENCY
 - a. All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selection or catalog is available through AHRI.
- 6. DELIVERY, HANDLING AND STORAGE
 - a. Comply with manufacturer's installation instructions for rigging, unloading, and transporting chillers.
 - b. Chiller shall be capable of withstanding -40°F (-40°C) to 158°F (70°C) storage temperatures for an indefinite period of time.

B. PRODUCTS

- 1. ACCEPTABLE MANUFACTURERS
 - a. Trane model CGAM
 - b. Approved equals by Carrier, Daikin and JCI. Must utilize scroll compressor and meet the specification including all scheduled performance.
- 2. CHILLER DESCRIPTION
 - a. The contractor shall furnish and install air-cooled water chiller with scroll compressors as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- 3. CHILLER OPERATION
 - a. Chiller shall be able to start and operate in ambient conditions from 0°F (-18°C) to 125°F (52°F). Wide ambient operation is accomplished with factory installed and

tested protection. If field installed wide ambient solution is used, this shall be purchased and installed at contractor expense.

- b. Chiller shall be capable of operating with a leaving solution temperature range 40°F to 65°F (4.4 to 20°C) without glycol.
- c. Chiller shall be capable of starting up with 95°F (35°C) entering fluid temperature to the evaporator. Maximum water temperature that can be circulated with the Chiller not operating is 125°F (52°C)
- d. Chiller shall provide evaporator freeze protection and low limit control to avoid low evaporator refrigerant temperature trip-outs during critical periods of chiller operation. Whenever this control is in effect, the controller shall indicate that the chiller is in adaptive mode. If the condition exists for more than 30 seconds, a limit warning alarm relay shall energize.
- e. Rapid Restart after power restoration. The Chiller shall be capable of starting in 45 seconds.

4. COMPRESSORS

- a. Construct chiller using fully hermetic scroll type compressors with R410A optimized and dedicated scroll profile.
- b. Provide direct drive motor cooled by suction gas with only three major moving parts and a completely enclosed compression chamber that leads to increased efficiency.
- c. Each compressor shall have overload protection internal to the compressor.
- d. Each compressor shall include: centrifugal oil pump, oil level sight glass and oil charging valve.
- e. Each compressor will have crankcase heaters installed and properly sized to minimize the amount of liquid refrigerant present in the oil sump during off cycles.

5. EVAPORATOR

- a. The evaporator shall be a high efficiency, brazed plate-to-plate type heat exchanger consisting of parallel plates. Braze plates shall be stainless steel with copper braze material.
- b. The water side working pressure shall be rated at 150 psig (10.3 bar) and tested at 1.5 times maximum allowable water side working pressure.
- c. The refrigerant side working pressure shall be rated at 460 psig (29.6 bars) and tested at 1.1 maximum allowable refrigerant side working pressure.
- d. Insulate the evaporator with a minimum of 0.75 inch (K=0.28) UV rated insulation. If the insulation is field installed, the additional money to cover material and installation costs in the field should be included in the bid.
 - i. Evaporator heaters shall be factory installed and shall protect chiller down to -20°F (-29°C). Contractor shall wire separate power to energize heat tape and protect evaporator while chiller is disconnected from the main power.
- e. Provide water drain connection, vent and fittings. Factory installed leaving water temperature control and low temperature cutout sensors.
- f. Water connections shall be grooved pipe.
- g. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

6. FANS

- a. Low sound fans shall be dynamically balanced and direct driven.
- b. All condenser fan TEAO motors have permanently lubricated ball bearings and external overload protection.

7. CONDENSER

- a. The condenser coils shall consist of copper tubes mechanically bonded into plate-type aluminum fins.

- b. The condenser coils shall have an integral sub-cooling circuit and shall be designed for at least 650 psig (44.8 bar) working pressure. Leak tested at 650 psig (44.8 bar).

8. ENCLOSURES/CHILLER CONSTRUCTION

- a. Units shall be constructed of a galvanized steel frame with galvanized steel panels and access doors.
- b. Chiller panels, base rails and control panels shall be finished with a baked on powder paint. Control panel doors shall have door stays.
- c. Mount starters and Terminal Blocks in a UL 1995 rated weatherproof panel provided with full opening access doors. If a circuit breaker is chosen, it should be a lockable, through-the-door type with an operating handle and clearly visible from outside of chiller indicating if power is on or off.
- d. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B117.

9. CHILLER MOUNTED STARTER

- a. The starter shall be across-the-line configuration, factory-mounted and fully pre-wired to the compressor motor(s) and control panel.
- b. Unit shall have a single point power connection.
- c. A control power transformer shall be factory-installed and factory-wired to provide unit control power.
- d. Control panel shall be dead front construction for enhanced service technician safety
- e. Unit wiring shall run in liquid-tight conduit.
- f. Power line connection type shall be standard with a terminal block.

10. REFRIGERANT CIRCUIT

- a. All chillers shall have 1 or 2 refrigeration circuits, each with two or three (manifolded) compressor on each circuit.

- b. Provide for refrigerant circuit:
- c. Liquid line shutoff valve
- d. Discharge service valve
- e. Filter
- f. Liquid line sight glass.
- g. Electronic expansion valve sized for maximum operating pressure
- h. Charging valve
- i. Full operating charge of R410A and oil.

11. CONTROLS

- a. Factory-mounted to the control panel door, the operator interface has an LCD touch-screen display. The interface shall be provided with cover to protect from UV light and weather damage.
- b. Display shall consist of a menu driven interface with easy touch screen navigation to organized sub-system reports for compressor, evaporator, and motor information as well as associated diagnostics.
- c. The chiller control panel shall provide password protection of all set-points
- d. Chilled water temperature control shall be microprocessor-based, proportional and integral controller to show water and refrigerant temperature, refrigerant pressure, and diagnostics. This microprocessor-based controller is to be supplied with each chiller by the chiller manufacturer.
- e. The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges:
 - i. Run time.
 - ii. Number of starts.
 - iii. Current chiller operating mode.
 - iv. Chilled water set point and set point source.
 - v. Electrical current limit set point and set point source.

- vi. Entering and leaving evaporator water temperatures.
 - vii. Saturated evaporator and condenser refrigerant temperatures.
 - viii. Evaporator and condenser refrigerant pressure.
 - ix. Differential oil pressure.
 - x. Phase reversal/unbalance/single phasing and over/under voltage protection.
 - xi. Low chilled water temperature protection.
 - xii. High and low refrigerant pressure protection.
 - xiii. Load limit thermostat to limit compressor loading on high return water temperature.
- f. Condenser fan sequencing to automatically cycle fans in response to load, expansion valve pressure, condenser pressure, and differential pressure to optimize chiller efficiency.
 - g. Display diagnostics.
 - h. Compressors: Status (on/off), %RLA, anti-short cycle timer, and automatic compressor lead-lag.
 - i. On chiller, mount weatherproof control panel, containing starters, power and control wiring, factory wired with terminal block power connection. Provide primary and secondary fused control power transformer.
 - j. The chiller controller shall utilize a microprocessor that will automatically take action to prevent chiller shutdown due to abnormal operating conditions associated with: evaporator refrigerant temperature, high condensing pressure and motor current overload.
 - k. Provide the following safety controls with indicating lights or diagnostic readouts.
 - i. Low chilled water temperature protection.
 - ii. High refrigerant pressure.
 - iii. Loss of chilled water flow.

- iv. Contact for remote emergency shutdown.
- v. Motor current overload.
- vi. Phase reversal/unbalance/single phasing.
- vii. Over/under voltage.
- viii. Failure of water temperature sensor used by controller.
- ix. Compressor status (on or off).

1. Provide the following operating controls:

- i. A variable method to control capacity in order to maintain leaving chilled water temperature based on PI algorithms. Five minute solid state anti-recycle timer to prevent compressor from short cycling. Compressor minimum stop-to-start time limit shall be 2 minutes. If a greater than 5 minute start-to-start, or greater than 2 minute stop-to-start timer is included, hot gas bypass shall be provided to insure accurate chilled water temperature control in light load applications.
- ii. Chilled water pump output relay that closes when the chiller is given a signal to start.
- iii. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance trip outs.
- iv. High ambient unloader pressure controller that unloads compressors to keep head pressure under control and help prevent high pressure nuisance trip outs on days when outside ambient is above design.
- v. Compressor current sensing unloader chiller that unloads compressors to help prevent current overload nuisance trip outs.
- vi. Low ambient lockout control with adjustable setpoint.
- vii. Condenser fan sequencing which adjusts the speed of all fans automatically in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing chiller efficiency.

- m. Provide user interface on the front of the panel. If display is on the inside of the panel, then a control display access door shall be provided to allow access to the display without removal of panels. Provide user interface with a minimum of the following features:
 - i. Leaving chilled water setpoint adjustment from LCD input
 - ii. Entering and leaving chilled water temperature output
 - iii. Pressure output of condenser
 - iv. Pressure output of evaporator
 - v. Ambient temperature output
 - vi. Voltage output
 - vii. Current limit setpoint adjustment from LCD input.
- n. The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature.
- o. Chiller shall have BACnet interface for integration into building automation system.

12. SOUND

- a. Acoustics: Manufacturer must provide both sound power and sound pressure data in decibels. Sound pressure data per AHRI 370 must be provided at full load. Sound levels shall not exceed the following.

63 hz	125 hz	50 hz	500 hz	1000 hz	2000 hz	4000 hz	8000 hz	A weighted
89	88	94	92	87	82	77	68	92

- b. If manufacturer cannot meet the noise levels, sound attenuation devices and/or barrier walls must be installed to meet this performance level.
- c. Provide acoustical treatment for compressor.

13. ACCESSORIES

- a. Unit shall be equipped with a factory-installed option consisting of louvered panels on the ends of the machine which firmly fasten to the machine frame. These panels shall cover the unit from the top to the bottom of the coils, thus providing protection of the coils from hail damage.

C. EXECUTION

1. INSTALLATION

- a. Install in accordance with manufacturer's requirements.
- b. Level the chiller using the base rail as a reference. The chiller must be level within 1/2" in over the entire length and width. Use shims as necessary to level the chiller.

2. SERVICE AND START-UP

- a. Startup - Provide all labor and materials to perform startup. Startup shall be performed by a factory-trained technician from the original equipment manufacturer (OEM). Technician shall confirm that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty. This shall be done in strict accordance with manufacturer's specifications and requirements. Third-party service agencies are not permitted.
- b. A start-up log shall be furnished by the factory approved start-up technician to document the chiller's start-up date and shall be signed by the owner or his authorized representative prior to commissioning the chillers.
- c. Chiller manufacturers shall maintain service capabilities no more than 50 miles from the jobsite.

3. Provide 5 year compressor warranty including parts and labor.

END OF SECTION 236400

SECTION 237300 – AIR HANDLING UNIT

A. GENERAL

1. Furnish and install air handling unit(s) as shown on plans with capacities indicated on plans.
2. Quality Assurance
 - a. Constant Volume Air Handling Units: Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430.
 - b. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-87.
3. Submittals
 - a. Submit unit performance including: capacity, nominal and operating performance.
 - b. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
 - c. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations. Indicate unit shipping, installation and operating weights including dimensions.
 - d. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.
4. Extra Stock
 - a. Provide one initial plus one spare set of all filters.
 - b. Provide spare set of drive belts.

B. PRODUCT

1. General
 - a. Factory fabricate air handling units of sizes, capacities, and configurations as scheduled on drawings and exactly as specified herein.
 - b. Units shall be by Trane, Carrier, JCI or Daikin.
2. Casing
 - a. Unit shall be constructed of a complete structural frame with removable panels. Removal of side panels shall not affect the structural integrity of the unit.
 - b. Construct casing sections located upstream of supply fan for operation at 4 inches water gage negative static pressure and casing sections located downstream of supply fan for operation at 6 inches water gage positive static pressure.
 - c. All exterior and interior panels shall be constructed of G90-U galvanized steel.
 - d. Seal and gasket all joints between exterior panels and structural frames with closed-cell foam gasketing for air seal and acoustical break.
 - e. Casing shall have full size removable access doors as scheduled on drawings.

Access doors shall have double wall construction. Provide automotive style neoprene gasketing around full perimeter of access doors to prevent air leakage. Provide "ventlock" style non-corrosive alloy latches operable from the inside or outside of unit.

- f. Insulate casing sections with 2" thick 1-1/2 pound per cubic foot density fiber glass insulation. Provide double wall casing construction and encase insulation between solid exterior and solid interior casing panels such that no insulation is exposed to airstream. Foil facing on insulation is not acceptable as alternate to double wall construction. Insulation shall comply with NFPA 90A
3. Drain Pan Construction
 - a. Provide insulated drain pans constructed of G90-U galvanized steel exterior panels and stainless steel interior liner. Encase insulation between exterior and interior walls. Insulation is closed cell foam injected with a R-value of 8. Stainless steel drain connection is required. Drain pans shall be sloped in 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. All drain pan connections will be to the side of the unit to enable proper trapping.
4. Fans
 - a. Provide supply fan section(s) with double width, double inlet centrifugal fan designed and suitable for class of service indicated in the unit schedule. Fan shaft to be properly sized and protectively coated with lubricating oil. Fan shafts shall be solid and properly designed so that fan shaft does not pass through first critical speed as unit comes up to rated RPM. Fans shall be statically and dynamically tested as an assembly at the required RPM to meet design specifications. Key fan wheels to fan shaft to prevent slipping.
 1. Provide self-aligning, grease lubricated pillow-block ball bearings selected for L-50 200,000 hour average life per ANSI/AFBMA 9. Extend both grease lubrication fittings to drive side of unit with plastic tubes and zerk fittings rigidly attached to drive side bearing support.
 - b. Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with 2 inch spring isolators. Install flexible canvas ducts between fan and casings to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A. If no isolators or flexible canvas duct is provided, then the entire unit shall be externally isolated from the supply ductwork and piping by contractor in order to avoid transmission of noise and vibration through the ductwork.
 - c. Fan sections shall have full height, double wall, hinged, removable access doors on drive side for inspection and maintenance of internal components.
 - d. Fans shall have shaft grounding rings.
5. Motors and Drives
 - a. Factory install all motors on slide base to permit adjustment of belt tension.
 - b. Fan Motors shall be inverter duty, premium energy efficiency open drip-proof.
 - c. V-Belt Drive shall be variable pitch rated at 1.5 times the motor nameplate.
 - d. Manufacturer shall provide for each fan a nameplate with the listed information to assist air balance contractor in start up:

1. Fan and motor Sheave part number
 2. Fan and motor bushing part number
 3. # of belts and part numbers
 4. Design RPM and Motor HP
 5. Belt tension and deflection
 6. Center distance between shafts
 - e. Motor shall be tested in accordance with NEMA MG-1 *Standard for General Purpose Industrial AC Small and Medium Squirrel-Cage Induction Motors*.
 - f. Motors shall satisfy the most current energy efficiency requirements issued by the US Department of Energy in their reference document *Energy Conservation Standards for Commercial and Industrial Electric Motors*, otherwise known as 10 CFR Part 431 *Integral HP Motor Final Rule*.
6. Coils
- a. Coils shall be manufactured by the same company as the supplier of the air handling unit. Install coils such that headers and return bends are enclosed by unit casings.
 - b. Construct coils of configuration plate fins and seamless tubes. Fins shall have collars drawn, belled and firmly bonded to tubes by means of mechanical expansion of tubes. Do not use soldering or tinning in bonding process.
 - c. Construct coil casings of stainless steel with formed end supports and top and bottom channels. If two or more coils are stacked in unit, install intermediate drain channels between coils to drain condensate to main drain pans without flooding lower coils or passing condensate through airstream.
 - d. Coils
 1. Clearly label supply and return headers on outside of units such that direction of coil water-flow is counter to direction of unit air- flow.
 2. Coils shall be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
 3. Construct headers of round copper pipe.
 4. Construct tubes of 1/2 inch O.D. minimum .016 inch thick minimum copper and construct fins of aluminum.
 5. Capacity shall be as indicated on plans.
7. Filters
- a. Provide factory fabricated filter segment of the same construction and finish as unit casings. Filter sections shall have filter guides and full height, double wall, hinged, removable access doors for filter removal. Construct doors in accordance with Article 2 Paragraph E. Provide filter blockoffs as required to prevent air bypass around filters.
 - b. Provide MERV 13 disposable filters.
8. Dampers
- a. Provide low leak outside air dampers as scheduled on drawings. Dampers shall be Ruskin CD60 double skin airfoil design or equivalent. Provide opposed blade action with metal compressible jamb seals and extruded vinyl blade edge seals. Blades shall rotate on stainless steel sleeve bearings. Damper blade lengths shall not exceed 60 inches. Leakage rate shall not exceed 5 CFM/square foot at one inch water gage and 9 CFM/square foot at 4 inches water gage. All Leakage testing and pressure ratings will be based on

AMCA Publication 500.

9. Access Sections

- a. Access for inspection and cleaning of the unit drain pan, coils and fans segments shall be provided. The unit shall be installed for proper access. Procedure for proper access, inspection and cleaning of the unit shall be included in the maintenance manual. Access section shall have double wall, hinged, removable access doors on one sides of sections. Construct doors per Article 2 Paragraph E.

C. EXECUTION

1. Install unit(s) as detailed on plans.
2. Controls shall be as indicated on plans.
3. Unit shall be set on 4" concrete curb. Paint curb safety yellow and shall extend 6" beyond the footprint of the equipment.

END OF SECTION 237300

SECTION 238239 – ELECTRIC UNIT HEATER

A. GENERAL

1. Heating units shall be installed where indicated on the drawings.
2. All heating units shall be by the same manufacturer.
3. Heating units shall be Q-Mark, Markel, or approved equivalent.

B. PRODUCT

1. Heating units shall be shall UL listed.
2. Heating units shall be provided with baked-on enamel finish.
3. Heating element to be heavy-duty steel finish brazed to steel sheathed turbulence elements.

C. EXECUTION

1. Unit(s) shall be installed as shown on the drawings.
2. Unit(s) shall be provided with accessories noted on the drawings.

END OF SECTION 238239

ELECTRICAL SPECIFICATIONS INDEX

260000	GENERAL PROVISIONS (ELECTRICAL) CONTRACT
260520	WIRES AND CABLES
260533	BOXES AND CABINETS
260645	CONDUIT AND CONDUIT FITTINGS
260553	ELECTRICAL IDENTIFICATION
260800	ELECTRICAL COMMISSIONING REQUIREMENTS
262213	DRY TYPE TRANSFORMERS
262413	SERVICE ENTRANCE SWITCHBOARD
262416	PANEL BOARDS AND CIRCUIT BREAKERS
262419	MOTOR CONTROL CENTER
262500	TRACK BUSWAY SYSTEM
262726	WIRING DEVICES
262727	DISCONNECTS
265100	LIGHTING FIXTURES
271000	TELECOMMUNICATION DISTRIBUTION SYSTEM
283100	ADDRESSABLE FIRE ALARM SYSTEM
285000	BI-DIRECTIONAL ANTENNA SYSTEM (BDA)
285500	RF SURVEY FOR EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM



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SECTION 260000 - GENERAL PROVISIONS (ELECTRICAL) CONTRACT

A. GENERAL

1. Scope of Work

- a. This Contractor shall provide all materials, equipment and labor necessary to install and set into operation the electrical equipment as shown on the Engineering Drawings and as contained herein.

2. Quality Assurance

- a. See the General and Supplementary General Conditions.
- b. All work shall be in accordance with the North Carolina State Building Code, which includes the 2020 edition of the National Electrical Code.
- c. Wherever the words "Approved", "Approval", and "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
- d. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- e. All material and equipment that the Contractor proposes to substitute in lieu of those specified shall be submitted to the Engineer ten (10) days prior to the bid date for evaluation. The submittal shall include a full description of the material or equipment and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Article 8 of the General Conditions will be followed for substitutions after award of Contract.

3. Submittals

- a. See General and Supplementary General Conditions and Division 1.
- b. Within ten (10) days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit for approval to the Architect/Engineer a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval.
- c. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitution for specified items. Acceptance for approval shall be in writing from the Engineer.

- d. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.
 - e. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions, parts lists, electrical circuit wiring diagrams, all submittal data, and sufficient manufacturer's literature to operate and maintain all equipment.
 - f. The Contractor shall submit to the Engineer a duplicate set of final electrical inspection certificates prior to final payment.
4. Product Delivery, Storage and Handling
- a. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
 - b. The Contractor shall protect all material and equipment from breakage, theft or weather damage. No material or equipment shall be stored on the ground.
 - c. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
5. Work conditions and Coordination
- a. The Contractor shall review the mechanical plans to establish points of connection and the extent of electrical work to be provided in his Contract.
 - b. This Contractor shall be responsible for all electrical work and make final connections to equipment installed in his Contract. Unless otherwise noted, this Contractor shall wire to disconnect switches, junction boxes, or circuit breakers as provided in his Contract.
 - c. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be approved by Architect/Engineer and shall be at the Contractor's expense with no extra cost to the owner.
6. Guarantee
- a. See the General and Supplementary General Conditions.
 - b. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Owner.

B. PRODUCT

- 1. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the Contractor's expense.

2. The Contractor shall provide nameplates for identification of all equipment, switches, panels, transformers, etc. See specification section 26 05 53 Electrical Identification.
3. All materials and equipment shall be approved third party agencies or bear re-examination listing where such approval has been established for the type of device in question. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment

C. EXECUTION

1. Inspection

- a. If any part of this Contractor's work is dependent for its proper execution or for its subsequent efficiency or appearance on the character or conditions of contiguous work not executed by him, the Contractor shall examine and measure such contiguous work and report to the Architect or Engineer in writing any imperfection therein, or conditions that render it unsuitable for the reception of this work. Should the Contractor proceed without making such written report, he shall be held to have accepted such work and the existing conditions and he shall be responsible for any defects in this work consequent thereon and will not be relieved of the obligation of any guarantee because of any such imperfection or condition.
- b. It is the responsibility of the electrical contractor to notify **Town of Winterville Electrical Inspector** to schedule required inspections including rough-in, above ceiling and final inspections.

2. Installation

- a. All work shall be performed in a manner indicating proficiency in the trade.
- b. All conduit, pipes, ducts, etc., shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- c. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- d. All patching shall be done in such a manner as to restore the areas or surfaces as to match existing finishes.
- e. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through poured masonry floors or walls above grade required for passage of all conduits, pipes or duct installed by him. The Contractor shall furnish and install all inserts and hangers required to support his equipment.
- f. Grounding

- 1) All grounding shall be in accordance with the requirements of the NEC. The main secondary service ground from transformer service entrance shall be bare copper wire in conduit clamped to building structural steel. Bond ground wire to conduit at each end. Bond system neutral bus to equipment grounding bus. In addition, cad weld to 10"x 3/4" diameter copper clad steel driven ground rod and clamp to metal cold water main. See the Electrical Riser Diagram.
 - 2) Install a separate green grounding conductor with the circuit conductors in each conduit. Use of the conduit only shall not be an acceptable means of equipment grounding.
 - 3) Install ground wire in all flexible connections (flex shall not be acceptable for grounding purposes), and in all Wiremold.
 - 4) All grounding conductors shall be sized per Article 250.122 of the NEC.
 - 5) The ground system shall be tested with a ground resistance and soil resistivity tester and the test report submitted to the Engineer. If resistance exceeds 25 ohms provide an additional driven ground rods separated by a minimum of 6' interconnected with #3/0 copper. A copy of the test report shall be submitted to the engineer to be included in the project closeout document.
 - 6) All ground points shall be accessible for inspection.
 - 7) Boxes with concentric, eccentric or over-sized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250.122 and lugged to the box.
- g. Electrical Identification. See section 26 05 53
- h. Arc Flash Hazard Assessment:
- 1) The contractor shall furnish a complete analysis of the available arc fault from the service entrance down to the 120/208V bus level.
 - 2) The contractor is responsible for verifying breaker types, estimating feeder lengths, and determining conductor types.
 - 3) The report shall include the following:
 - 3.1) Data entry and system one-line modeling in SKM or equivalent modeling software.
 - 3.2) Arc Flash Hazard Assessment to include the following:
 - 3.2.1) Short Circuit Study
 - 3.2.2) Protective Device Coordination
 - 3.2.3) Arc Flash Evaluation Report

- 3.2.4) Arc Flash Bus Detail
 - 3.2.5) Energized Work Permits
 - 3.2.6) Single-line Drawings of electrical equipment
- 4) Provide Arc Flash Hazard Labels.
 - 4.1) Label shall include information from the report for the equipment.
 - 4.2) Labels are required at switch board, panel boards and motor control center.
 - 4.3) Label shall include arc-flash hazard warning per NEC 110.16(A) and 110.16(B).
 - 4.4) The contractor is responsible for applying arc flash labels to equipment.
 - 5) Furnish 1 hard copy and 1 electronic copy of the report to the engineer of record and the owner.
 - 6) The contractor shall adjust the settings of adjustable trip breakers as directed by the protective device coordination study.
- i. Required labels for switch board, panel boards, disconnects and motor control center:
 - 1) Provide arc-flash hazard warning per NEC 110.16(A) and 110.16(B)
 - 2) Available fault current per NEC 408.6.
- 2) Performance
 - a. The Contractor shall perform all excavation, backfilling, and patching operations as indicated on the drawings.
 - 3) Erection
 - a. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.
 - 4) Field Quality Control
 - a. The Contractor shall conform to the requirements of Division 3 for concrete testing.
 - b. The Contractor shall test his entire installation and shall furnish the labor and materials required for these tests. Tests shall be performed in accordance with the requirements of the particular section of the specifications and in accordance with the requirements of the State Ordinances and Codes, and the National Electrical Code. The Contractor shall notify the Engineer of his readiness for such test. Final inspections by the N.C. Department of Insurance and N.C. Department of Administration (State Construction

Office) are required, as State Inspectors' Certificates are required, prior to authorization of final payment.

- c. Testing required for compliance with the Contract shall be stated in subsequent sections. All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information. All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.
- d. Documentation
 - 1) All tests specified shall be completely documented indicating time of day, date, temperature and all pertinent test information.
 - 2) All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.
- 5) Adjust and Clean
 - a. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.
 - b. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for the intended service. In no event shall nameplates be painted.
 - c. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).

END OF SECTION 260000

SECTION 260520 - WIRES AND CABLES

A. GENERAL

1. All conductors shall be properly marked showing manufacturer's name, insulation type, voltage rating and wire size. All insulation is to be rated for minimum of 600 volts.
2. Wire sizes shall be as shown. No wire smaller than No. 12 AWG shall be used. The maximum conductor size shall be 500 KCMIL.
3. Where the conductor length from the panel to the first outlet on a 120 volt exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall be increased by at least one size. Provide associated drawing modifications as needed for compliance with NEC Art 250.122(B) proportional increase in equipment ground conductor wherever ungrounded conductor sizes are increased for voltage drop.
4. Conductors shall be manufactured by US Wire and Cable, Triangle, Okonite, Southwire, or approved equivalents.
5. Wiring for 120/208 volt, 240 volt and 277/480 volt systems shall not be mixed in the same race way, pull or junction box.

B. PRODUCT

1. All conductors shall be copper and shall conform to Underwriters' Standards. Wires No. 10 and smaller shall be solid. Wires 8 and larger shall be stranded.
2. All wire shall be labeled two (2) feet on centers giving size, type voltage, rating, and manufacturer's name. Wire #6 and smaller #6 shall be factory color coded. Wire larger than #6 may be color coded with Okonite 2000 volt colored tape at all terminals of the run, and at all junctions.
3. Where applicable, all wire shall be color coded as follows, or approved by the Engineer:
 - a. 120/208 or 240-volt (no neutral) system:

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

- b. 277/480-volt system:

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Natural Gray
Ground	Green

4. Insulation type shall be UL labeled for the appropriate type of use and temperature. Insulation types are as follows:
 - a. The insulation type for interior wiring shall be dual-rated THHN/THWN or XHHW.
 - b. The insulation type for wiring in exterior wet locations shall be THWN-2 or XHHW-2.

C. EXECUTION

1. Conductors shall be run in conduit and shall be continuous from outlet to outlet. Splices will not be made except within accessible outlet or junction boxes, troughs, or gutters.
2. Solid conductors shall be spliced by using Ideal "wing-nuts", 3M Company's "Scotchlok" connectors for branch circuit splices. Crimp connectors will not be allowed for branch circuit splicing.
3. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.
4. On mechanical splices, taps or joints taping shall be with at least two (2) layers of approved gum rubber tape which will be laid on the half-lap followed by at least one (1) layer of friction or plastic tape laid on with half-lap. It is intended that all taping shall be a permanently secured insulation equal to that of the wire.
5. All conductors in any conduit shall be at one specific voltage. Conductors of different voltages shall be run in separate conduits.
6. Neutral conductors shall be properly installed as to prevent grounding of the neutrals in any conduit. Multi-wire circuits with shared neutral conductors are not allowed. Each single pole load shall have individual neutral for each circuit.
7. Neatly train and lace wiring inside boxes, equipment, and panelboards.
8. Make conductor lengths for parallel circuits equal.
9. Pull all conductors into a raceway at the same time. Use third party approved wire pulling lubricant for pulling #4 AWG and larger wires.
10. Insulation Resistance Testing.

All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500 volt insulation resistance testing. The procedures listed below shall be followed:

- a. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire or larger, between conductors and between conductor and the grounding conductor.

- b. 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 insulation resistance testing reading between the neutral bar and the grounded enclosure. 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.
 - c. The contractor shall send a letter to the engineer certifying that the above has been done and tabulating the insulation resistance testing readings for each panel. This shall be done at least four (4) days prior to the final inspection.
11. Use of split bolt connectors is not acceptable.
12. Prior to energizing, feeders and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be included with the project record document.
13. Voltage Drop:
- a. 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 drops on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).
 - b. Where the conductor length from the panel to the first outlet on a 277-volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Conductor size of remaining branch circuit shall increase as needed to meet above voltage drop limitations.
 - c. Where the conductor length from the panel to the first outlet on a 120-volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Conductor size of remaining branch circuit shall increase as needed to comply with above voltage drop limitations.
 - d. Provide associated drawing modifications as needed for compliance with NEC Art 250.122(B) proportional increase in equipment ground conductor wherever ungrounded conductor sizes are increased for voltage drop.

END OF SECTION 260520

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SECTION 260533 - WIRES AND CABLES

A. GENERAL

1. The Electrical Contractor shall provide junction boxes, pull boxes, cable, support boxes, and wiring troughs as required by NEC and as otherwise indicated in the Drawings.
2. All necessary mounting hardware and accessories shall be provided for a complete installation.

B. PRODUCT

1. Outlet and junction boxes shall be 4" minimum size, octagonal in ceilings, 4" square or rectangular (4" x 4" minimum for walls) except as noted below. Ceiling outlet boxes shall not be less than 1 1/2" deep, but in no case shall the size and depth of boxes be less than the required by the NEC.
2. Outlet boxes shall be equipped with plaster rings of appropriate depth to finish flush with finished walls. Outlets in exposed masonry wall shall be equipped with extra deep square corner tile rings so that box may be installed in the core of the block.
3. Outlets for concealed work and ceiling outlets for exposed work shall be galvanized stamped steel. Boxes shall be as manufactured by Steel City Electric Company, Metropolitan, B & C or equivalent.
4. Wall outlets for exposed conduit work shall be Crouse- Hinds, Appleton, Walker, or equal, series FS and FD switch and receptacle threaded hub boxes, with matching FS and FD covers.
5. Junction boxes for change of direction or feeder taps shall be furnished where required, shall be of adequate size to prevent crowding conductors in accordance with the requirements of the electrical code and job requirements and shall be accessible.
6. Junction boxes on finished wall and ceilings shall be flush with covers.
7. Junction boxes larger than 5" square shall be galvanized and without pre-formed knockouts.

C. EXECUTION

1. Boxes and troughs shall be supported independently of conduit entering them. Brackets, threaded rod hangers with lock nuts, bolts, or other suitable supporting methods may be used.
2. Thru-the-wall outlet boxes shall not be permitted. Outlet boxes shown back to back on plans, shall be separate boxes connected where required using a loop of flexible metallic conduit with ground wire. Boxes shall be separated a minimum of 18 inches apart.
3. In general, outlets shall be installed at the heights indicated on the fixture and symbol legend.
4. Each outlet designated on the plans shall be provided with an outlet box.
5. Each outlet box which supports a fixture shall be provided with a fixture stud into the outlet box. Outlet box and/or fixture stud shall be attached with not less than three screws or bolts.
6. Exterior outlets shall be provided with watertight gaskets and covers.

END OF SECTION 260533

SECTION 260545 - CONDUIT AND CONDUIT FITTINGS

A. GENERAL

1. Conduit shall be delivered to the project site in bundles of full length pipes, each length marked with the trademark of the manufacturer and the Underwriters' Laboratories, Inc. stamp. Each conduit length shall be straight, true and free from scales, blisters, burrs and other imperfections.
2. Within the building parameters and above the floor slab, the rigid steel conduit specified shall be used unless specifically noted otherwise.
3. Conduit size for control wiring shall be a minimum of one-half (1/2) inch conduit. All branch circuit conduit shall be a minimum of one-half (1/2) inch. Percent filled and derating shall be in accordance with the National Electrical Code. Flexible metal and water-tite ("sealtite") conduit in size 1/2" and larger shall be acceptable for motor, appliance, and fixture connections from fixture junction boxes or appliance/motor disconnects provided a ground wire is installed in the flex and the flex assembly is an integral part of the fixture, shipped from the same factory as the fixture, and 3rd party agency approved for such use. The third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. This same requirement shall apply for motor/appliance connections.
4. All conduit shall be installed in accordance with the National Electrical Code.
5. Metallic conduits shall be manufactured by Allied, Wheatland, Cruse-Hinds, or equivalents.
6. Non-metallic conduits shall be manufactured by Prime Conduit, Cantex, Champion Fiberglass or equivalents.
7. Conduit fittings shall be manufactured by Rayco, T & B, Crouse Hinds, O-Z/Gedney or equivalents.
8. Conduit fittings shall be manufactured by Rayco, T & B, Crouse Hinds, or equivalents.
9. Surface mounted raceway shall be used as noted on the plans in lieu of exposed conduit. Surface mounted raceway shall be manufactured by Wiremold or approved equivalents. A separate ground wire shall be run in the surface mounted raceway.

B. PRODUCT

1. Thin Wall Conduit and Fittings
 - a. Electrical metallic tubing (EMT) shall be cold-rolled steel tubing with zinc coating on the outside and protected on the inside by a zinc, enamel or equivalent corrosion-resistant coating conforming to the latest requirements of ANSI. Conduit shall meet the Rigid Conduit Association Standards.

- b. Electrical metallic tubing fittings shall be all steel plated hexagonal threaded compression type. No pot metal, indenter, or set screw fittings, shall be used. EMT connectors shall have insulated throats.
2. Rigid Steel Conduit and Fittings
- a. Rigid steel conduit, including elbows and nipples, shall be standard weight, mild steel pipe, hot dipped galvanized, sherardized or zinc-coated conforming to the requirements of ANSI C80.1, 1966 or later edition. Rigid steel conduit shall also meet the latest requirements of Underwriters' Laboratories, Inc. Standards for Rigid Metallic Conduit.
 - b. Fittings shall be all steel plated hexagonal threaded fitting.
3. Flexible Metal Conduit and Fittings
- a. Flexible metal conduit shall be of the best grade interlocking spiral strip steel. The interlocking spiral strip construction shall be such as to permit bending of the conduit to a radius of four (4) times its internal diameter without distorting at any point. The interior and the exterior of the flexible conduit shall be smooth and free of burrs, sharp edges, or other defects which could damage the wire.
 - b. Fittings shall be of the approved types, made of malleable iron and hot dipped galvanized.
 - c. All connectors shall be steel compression fittings with insulated throats.
 - d. Where water tight flexible conduit is required, it shall have an outer sheath of material similar to PVC.
4. Non-metallic Conduit
- a. Non-metallic conduit shall be UL listed, for its particular application. It shall be resistant to sunlight and chemical and moisture atmospheres and rated for use with 90 degrees Celsius conductors.
 - b. The installation and usage of rigid non-metallic conduit shall comply with Article 352 of the National Electrical Code, along with any related or referenced sections.

C. EXECUTION

1. General

- a. All conduit shall be run tight against walls, columns or ceilings.
- b. The conduit shall bend cold 90 degrees about a radius equal to ten (10) times its own diameter without signs of flaw or fracture in either pipe or protective coverings. All bends and offsets shall be made on a forming tool to prevent the conduit or its coating from being damaged in the bending. Conduit bends shall have a radius not less than ten (10) times the conduit diameter.

- c. Where conduits join any couplings or threaded fittings, the ends shall be made watertight. (All conduit runs, including boxes, couplings, and fittings used therein, shall be so installed and equipped as to prevent water from entering the conduit.)
 - d. All conduits shall be carefully cleaned before and after erection. After cleaning, all ends of conduits shall be free from burrs and inside surfaces shall be free from imperfections likely to injure the wires or cables.
 - e. In every instance, conduit shall be installed in such a manner that the conductors may readily and easily be drawn or pulled in without strain or damage to the insulation; and, also, so that defective conductors may be readily and easily withdrawn and replaced by new conductors. Long radius bends and a sufficient number of approved pull and junction boxes shall be approved for this purpose, and as may be directed by the Engineer. All conduit shall be securely supported and grounded.
 - f. In unfinished areas, exposed conduit shall be run to conform to the building lines with special emphasis on neatness. Turns shall be made with galvanized outlet boxes, junction boxes, factory fittings and/or symmetrical bends. Locknuts and bushings shall be employed to provide full grounding and adequate protection of insulation. Double locknuts shall be used on all conduits entering sheet metal enclosures.
 - g. Support for all conduit shall be in accordance with the National Electrical Code. Conduit shall be supported by approved pipe straps or clamps, secured by means of toggle bolts on hollow masonry; expansion shields and matching screws or standard pre-set inserts on concrete or solid masonry, machine screws or bolts on metal surfaces, and wood screws on wood construction. Powder actuated fasteners are not allowed on State projects.
 - h. All empty conduit systems shall be capped or terminated in a junction box and shall be provided with nylon pull cord inside for future use.
 - i. Conduit terminating below grade shall be provided with means to prevent entry of dirt or moisture. Depth of burial shall not be less than two (2) feet below grade. All termination points shall be accurately marked and dimensioned on the As-Built Plans.
 - j. Where conduits of any type pass over a building expansion joint, a standard "expansion joint fitting" compatible with the type of raceway shall be provided.
 - k. Conduits installed on the interior of exterior building walls shall be spaced off the surface a minimum of 1/4" using "clamp-backs" or strut.
2. Thin Wall Conduit and Fittings
- a. Except for service and feeder conduits, electrical metallic tubing and fittings may be installed in lieu of rigid conduit in dry construction in furred spaces, ceiling cavities, chase spaces, interior portions other than concrete and solid plaster, or for exposed work except on mechanical structure or supports.
 - b. Electrical metallic tubing shall not be installed.
 - 1) Where exposed to severe corrosive conditions and/or severe physical damage,

- 2) Nearer than four (4) feet from finished floor in exposed areas
 - 3) In trade sizes larger than two (2) inches
 - 4) Located in exterior walls or in poured concrete.
 - 5) Any location outdoors.
 - 6) Where tubing, coupling, elbows and fittings would be in direct contact with the earth or underground (in/below slab-on-grade or in earth).
- c. A transition between a run of rigid conduit concealed in a wall and a run of thin wall conduit along a ceiling shall be made in an outlet box above the ceiling, if accessible, near the wall.
3. Rigid Steel Conduit and Fittings
- a. All conduit terminations shall be provided with insulating bushings.
 - b. Condulet fittings shall not be used in lieu of pull boxes.
 - c. Except where located under the ground floor slab, all service and feeder conduit shall be heavy wall (rigid galvanized).
 - d. Rigid steel conduit shall be installed in exterior masonry walls, in wet locations where subject to severe physical damage, or where conduit trade size is two and one half (2 1/2) inches or larger.
4. Flexible Metal Conduit and Fittings
- a. Flexible metallic conduit shall be provided at the end of each conduit run terminating at the conduit box on electric motors, transformers or other equipment.
 - b. The length of flexible conduit shall be in accordance with the National Electric Code.
5. Non-Metallic Conduit
- a. Thin wall rigid non-metallic conduit (schedule 40 PVC) shall only be used for concrete encasement.
 - b. Except where embedded in concrete, conduit shall be supported to permit adequate lineal movement to allow for expansion and contraction of conduit due to temperature change. Where a temperature change in excess of 14 degrees Celsius is anticipated, such as direct burial, exposed outside of the building, or in un-insulated spaces inside the building (attics, crawl spaces, etc.), expansion joints shall be installed in accordance with the manufacturer's specifications.
 - c. Heavy wall non-metallic conduit (schedule 80 PVC) shall be used where conduits are direct buried exterior to the building or exposed exterior to the building.

- d. PVC schedule 40 shall not be used exposed or concealed in gypsum wall, but may be used in CMU walls. PVC schedule 40 may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be $\frac{3}{4}$ inch at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage. The placement of conduit in floor slabs must be thoroughly coordinated with the structural design. Potential conflicts with steel reinforcing bars and reductions in net concrete sections are among the issues that must be considered by the structural engineer.
6. Underground Raceways
- a. Where conduit is installed under the ground floor slab within the building foundations, schedule 40 PVC conduit shall be used. At the Contractor's option, this installation may consist of galvanized steel conduit encased with three (3) inches of concrete or rigid steel conduit with a minimum of 15 mils of PVC coating. Where thin wall non-metallic conduit is used under the ground floor slab, the elbows and turn out required to turn the raceway up into cabinets, equipment, boxes, etc. shall be of rigid steel.
 - b. Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of three (3) inches of concrete on all sides.
 - 1) Encased raceways must have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which must have a minimum cover of thirty (30) inches.
 - 2) Encased raceways shall be of a type approved by the NEC as "suitable for concrete encasement."
 - c. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as "suitable for direct burial." Minimum raceway size shall be 1 inch.
 - d. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
 - e. Raceways run underground internal to building foundation walls shall be of a type and installed by a method approved by the NEC.
 - f. Where underground raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel.
 - g. The raceway system shall not be relied on for grounding continuity.

- 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" thru-wall fitting with "FSKA" membrane clamp adapter if required.
7. Ductbank
- a. Excavation and backfill shall conform to "Division 2" of the specifications except heavy-duty, hydraulic-operated compaction equipment shall not be used.
 - b. Trenches should be cut neatly and uniformly, sloping uniformly to required pitch.
 - c. Ducts should be pitched to drain toward manholes and handholes and away from buildings and equipment. Minimum slope shall be 4 inches in 100 feet. Where necessary to achieve this between manholes, ducts should be sloped from a high point in the run to drain in both directions.
 - d. Concrete encased nonmetallic ducts shall be supported on plastic separators coordinated with duct size and spacing. Separators shall be spaced close enough to prevent sagging and deforming of ducts. Separators to the earth and to ducts should be secured to prevent floating during placement of concrete. Steel or tie wires should not be used in such a way as to form conductive or magnetic loops around ducts or duct groups.
 - e. Waterproof marking cord should be installed 130-pound tensile test (marked at least every foot), equivalent to Greenlee No. 435, in all ducts, including spares, after thoroughly rodding, clearing and swabbing all lines free of any and all obstructions.
 - f. All ducts should be sealed at terminations, using sealing compound and plugs, as required to withstand 15 psi minimum hydrostatic pressure.
 - g. The arrangement of conduit in ductbank should be in accordance with OSHA requirements.

END OF SECTION 260545

SECTION 260553 - ELECTRICAL IDENTIFICATION

A. GENERAL

1. 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.
2. Identify all disconnecting means in accordance with NEC 110.22(A).
3. Furnish and install self-adhesive plastic tape for all receptacle and wall switch cover plates indicating circuit numbers.

B. PRODUCT

1. Nameplates:
 - a. Nameplates shall remain legible. Embossed, self-adhesive plastic tape is not acceptable for marking equipment.
 - b. Name plates shall be laminated phenolic plastic with engraved letter. Letters shall be approximately 1/2-inch high except where resultant nameplate size exceeds equipment size. Nameplate lettering may be adjusted accordingly with approval of the Engineer.
 - c. Nameplate material colors shall be:
 - Blue surface with white core for 120/208-volts equipment.
 - Black surface with white core for 277/480-volts equipment.
 - Bright red surface with white core for all equipment related to fire alarm system.
 - Dark red (burgundy) surface with white core for all equipment related to security.
 - Green surface with white core for all equipment related to emergency systems.
 - Orange surface with white core for all equipment related to telephone systems.
 - Brown surface with white core for all equipment related to data systems.
 - White surface with black core for all equipment related to paging systems.
 - Purple surface with white core for all equipment related to TV systems.
2. Self-adhesive plastic tape:
 - a. All text shall be type written by the tape compatible equipment. No handwritten.

C. EXECUTION

1. Nameplates shall be securely attached to equipment using two-part epoxy adhesive suitable for location where installed. In outdoor locations, labels applied using two-part epoxy shall be weatherproof and sunlight resistant.
2. 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 tags with string or wire attached to conduit or outlet.
3. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined above. This includes covers on boxes above lift-out and other type accessible ceilings, where identification shall also include branch circuit designation.

END OF SECTION 260553

SECTION 260800 - ELECTRICAL COMMISSIONING REQUIREMENTS

A. GENERAL

1. DESCRIPTION

- a. Commissioning
Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing adjusting and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
- b. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
- c. Verify and document proper functional performance of equipment and systems.
- d. Verify that O&M documentation left on site is complete.
- e. Verify that the Owner's operating personnel are adequately trained.

2. RELATED WORK

- a. Section 23 0900 – Instrumentation and Controls for HVAC

3. ABBREVIATIONS AND DEFINITIONS

- a. A/E: Architect, Architect/Engineer, Engineer and/or Design-Builder
- b. ASI: Architectural Supplemental Instruction
- c. BAS: Building Automation System
- d. BoD: Basis of Design. A narrative of how the designer plans to achieve the OPR.
- e. CxA: Commissioning Authority
- f. CC: Controls Contractor
- g. CM: Construction Manager
- h. Cx: Commissioning
- i. Cx Plan: Commissioning Plan

- j. DDC: Direct Digital Control System
 - k. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents and cannot be corrected in five (5) minutes time.
 - l. FT: Functional Performance Test
 - m. MC: Mechanical Contractor
 - n. O&M: Operation and Maintenance
 - o. OPM: Owner Project Manager
 - p. OPR: Owner Project Requirement. A dynamic document expressing how the owner expects the building systems to perform upon project completion.
 - q. PC: Prefunctional Checklist
 - r. Sub(s): Subcontractors or Prime Contractor
 - s. TAB: Test, Adjust and Balance
4. Electrical EQUIPMENT AND SYSTEMS TO BE COMMISSIONED
- a. Electrical Systems
 - 1) Service Switchboard
 - 2) Motor control centers.
 - b. Lighting Control Panel.
 - c. Electric metering Interface with Building Automation System
5. SUBMITTALS
- a. Provide the CxA a copy of the following items, for the systems to be commissioned:
 - b. Equipment and System Submittals to include, at minimum, the following:
 - 1) Equipment Data Sheets
 - 2) Performance data

- 3) Manufacturer's pre-startup checklists
- 4) Manufacturer's start-up checklists
- 5) Installation Instructions
- c. Shop drawings (including any resubmittals required by the A/E)
- d. Piping - Supply one copy of all hydrostatic pressure test results
- e. Initial Pre-startup and start-up plan
- f. Startup Testing Report
 - 1) Prepare startup testing report on a per system basis, documenting the results of executed testing plan.
 - 2) Copies of all completed test forms and checklists shall be provided.
 - 3) List of all outstanding deficiencies and uncompleted items.
- g. Operational and maintenance documentation
- h. Training plan and training materials
- i. As-built documentation
- 6. SEQUENCE OF OPERATIONS
 - a. Not Applicable.

B. PRODUCTS

1. TEST EQUIPMENT

- a. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

2. Cx WEB-BASED COMMISSIONING TOOL

- a. All web-based software required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Refer to respective specification sections for testing procedures.

C. EXECUTION

1. MEETINGS

- a. Prior to the start of construction, the mechanical and controls contractor will schedule a meeting with the commissioning authority to review the systems to be commissioned, the testing methodology, and other requirements.
2. START-UP, PRE-FUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT
- a. General
 - 1) Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.
 - 2) The prefunctional performance test checklists shall be developed by the CxA.
 - b. Start-up and Initial Checkout Plan
 - 1) The subcontractor responsible for providing and installing the equipment shall develop the full start-up plan by combining the prefunctional checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checkout and inspection of each piece of equipment and a summary statement with a signature block at the end of the checklist.
 - 2) The full start-up plan shall consist of:
 - The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
 - The manufacturer's normally used field checkout sheets
 - Specifically, the mechanical start-up plan shall also include the contractors TAB plan.
 - 3) The contractor submits the full startup plan to the CxA for review and approval.
 - 4) The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.
 - c. Execution of Prefunctional Checklists and Startup
 - 1) Two weeks prior to startup, the Subs and vendors schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When

checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.

- 2) The CxA and possibly the A/E will observe the procedures for selected pieces of primary equipment. It is the intent that the commissioning authority will observe the tests during contractor testing. If the contractor does not inform the commissioning authority of testing, the commissioning authority may request the contractor to repeat the test.
- 3) The CxA will observe the physical start-up of all major systems.
- 4) For lower-level components of equipment, (e.g., sensors, controllers), the CxA will observe a sampling of the prefunctional and start-up procedures.
- 5) The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA.
- 6) Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
- 7) Completed startup test report must be provided to CxA prior to functional testing.

d. Deficiencies, Non-Conformance and Approval in Checklists and Startup

- 1) The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
- 2) The CxA will work with the Subs and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
- 3) Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3. FUNCTIONAL PERFORMANCE TESTING

- a. This sub-section applies to functional testing and demonstration for equipment and system in this division. The functional testing check list shall be developed by the CxA.
- b. The general list of equipment and systems to be commissioned is found in section 1.4.
- c. Objectives and Scope

- 1) The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
 - 2) In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a specified system response. Verifying each sequence in the sequence of operation is required.
 - 3) Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
 - 4) The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, submittals, installation manuals, and O&Ms, shall be at the job site before functional testing commences.
- d. Development of Test Procedures
- 1) The CxA develops specific functional test procedures and forms to verify and document proper operation of each piece of equipment and system. The CxA provides a copy of the test procedures to the A/E, OPM and installing Sub who shall review the tests prior to testing. The A/E and Sub(s) shall point out to the CxA any specific problems related to feasibility, safety, equipment and warranty protection.
- e. Coordination and Scheduling
- 1) The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. Completed startup testing report must be provided to CxA prior to functional testing. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
 - 2) In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.
- f. Test Methods

- 1) Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
- 2) Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
- 3) Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
- 4) Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
- 5) Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.
- 6) Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
- 7) Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

g. Demonstration, Verification and Validation

- 1) Total Energy meter shall be tested for totalization.

2) Lighting control systems shall tested for operation.

3) Motor Control Center:

a. Control panels shall be tested for operation.

b. MCC shutdown shall be tested for operation.

h. Problem Solving

1) The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the CM, Subs and A/E.

4. OPERATION AND MAINTENANCE MANUALS

a. In addition to Installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing. O&M Manuals shall be in electronic form, the file format shall be Adobe Acrobat readable document. The document shall be formatted to include level 1 bookmarks that link to each main section of equipment.

5. TRAINING OF OWNER PERSONNEL

a. CxA shall document the completion of comprehensive Owner training. Training shall include the understanding of the systems and the operation and maintenance of each major piece of HVAC equipment, motor control centers or system.

b. Training shall include classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation.

END OF SECTION 260800

SECTION 262213 - DRY TYPE TRANSFORMERS

A. GENERAL

1. The Electrical Contractor shall provide dry type transformer(s) of the size and type as shown on the engineering plans.
2. Transformer(s) shall be manufactured by Square D or approved equivalents by ABB, Siemens, or Eaton.

B. PRODUCT

1. Transformer(s) shall be 480-volt delta primary. Secondary voltage and capacity shall be per indicated on plan. Transformer(s) shall be energy efficiency type. Minimum transformer efficiencies must satisfy efficiencies promulgated within the United States Code of Federal Regulations CFR Title 10 Chapter II Part 431 (Appendix A of Subpart K 2016) commonly referred to DOE 2016 Efficiency Levels.
2. Transformer shall be insulated with a 220°C temperature insulation system. Transformer shall be 115°C temperature rise and floor mounted with vibration isolation pads provided. Transformer shall be capable of carrying a 15% continuous overload, without exceeding a 150 °C rise. Required performance shall be obtained without exceeding the above rise in a 40°C maximum, 30°C average ambient temperature. Where floor mounted units are suspended, the type of suspension and vibration isolation shall be as detailed on the plans.
3. Transformer winding shall be copper.
4. Six 2 1/2% taps, two above and four below normal shall be provided.
5. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable Underwriters' Laboratory and National Electric Code standards.
6. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above 40°C ambient.

C. EXECUTION

1. Transformer(s) shall be installed in accordance with manufacturer's instructions and in compliance with the National Electric Code.
2. Unit(s) shall be mounted on a 3 1/2" high concrete pad furnished by the Electrical Contractor. The pad shall be 2500 PSI concrete and the pad size shall be greater than the transformer(s) size by a minimum of 4". Min. clearance to wall shall be 6" or per manufacturer instruction.
3. Make connections to transformer(s) with a minimum of one (1) foot of flexible conduit.

END OF SECTION 262213

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SECTION 262413 - SERVICE ENTRANCE SWITCHBOARD

A. GENERAL

1. The Electrical Contractor shall provide a main service entrance switchboard as shown on the drawings and as contained herein.
2. The switchboard(s) shall meet Underwriter's Laboratories enclosure requirements and shall be Square D by Schneider Electric, Eaton, ABB, or SIEMENS.
3. The switchboard(s) shall be U.L. listed, as suitable for use as a service entrance equipment, and bear all U.L. service equipment label.

B. PRODUCT

1. Enclosure Construction

- a. The switchboard framework shall be fabricated on a die-formed steel base or base assembly consisting of formed steel and commercial channel welded or bolted together to rigidly support the entire shipping unit for moving on rollers and floor mounting. The framework is to be formed code gauge steel, rigidly welded and bolted together to support all cover plates, bussing, and component devices during shipment and installation.
- b. Each switchboard section shall have an open bottom and individual removable top plate for installation and termination of conduit. Top and bottom conduit area is to be clearly shown and dimensioned on the shop drawings. The wireway front covers are to be hinged to permit access to the branch switch load side terminals without removing the covers. All front plates used for mounting meters, selector switches or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable and small enough for each handling by one man. The paint finish shall be gray enamel over a rust-inhibiting phosphate primer.
- c. The enclosure shall be front accessible only.

2. Bussing

- a. The switchboard bussing shall be copper with silver plating and of sufficient cross-sectional area to continuously conduct rated full load current with a maximum temperature rise of 50 degrees Celsius, above an ambient temperature of 25 degrees Celsius.
- b. The main horizontal bus bars between sections shall be located on the back of the switchboard to permit a maximum of available conduit area. Bus bars in the distribution section shall be of full length, to allow for future addition of circuit breakers up to the maximum number allowable for this size switchboard. The horizontal main bus bar supports, connections, and joints are to be bolted with grade 5 carriage bolts and Belleville washers to be free of required periodic maintenance.

3. Integrated Equipment Rating

- a. The bus bars shall be rigidly braced for 100,000 amp fault current (symmetrical), or as shown on the plans.
- b. Each switchboard, as a complete unit, shall be given a single integrated equipment rating by the manufacturer. The integrated equipment short-circuit rating shall certify that all equipment is capable of withstanding the stresses of a fault equal to that of the least overcurrent protective device contained therein or as specified. Such rating shall be established by actual tests by the manufacturer on a similar equipment construction as the subject switchboard. This test data shall be available and shall be furnished to the Engineer with the submittal of approval drawings.
- c. Provide phase loss protection with capacitor system back up.

4. Main Circuit Breakers

- a. The service disconnect shall be a equivalent to Square D Company PE type breaker, 100% rated with fixed mounted construction.

All trip unit adjustments shall be factory coordinated and set with the secondary breakers within the switchboard. Submit coordinated study to engineer for approval.

5. Molded Case Circuit Breakers

- a. All devices shall be U.L. listed and meet the latest version, as of the bid date, of NEMA Standards, Publication No. AB1.
- b. The breakers shall be quick-make and quick-break type. The breakers shall have wiping type contacts, arc chutes and common trip mechanisms for three pole breakers.
- c. All breakers shall be calibrated for operation in an ambient temperature of 40 degrees Celsius.
- d. All breakers shall of the minimum interrupting rating specified and of the trip size shown on the plans.

6. Maintenance Mode Switches:

- a. Description: Local, lockable switch with blue status indicator light that permits selection of maintenance mode with alternate electronic trip unit settings for reduced fault clearing time in accordance with NFPA 70.
- b. Provide for circuit breakers 1,200 A and larger.
- c. Switch Type: Provide [energy reduction maintenance settings (ERMS) switches
 - 1) ERMS Switches: Clearing time of less than 50 milliseconds when activated.

- d. Insulated Case Circuit Breakers (ICCBs) and Power Circuit Breakers (PCBs) with ERMS: Provide Android/iOS mobile application that enables remote maintenance mode activation, at distance typically greater than 33 feet (10.1 m) line-of-sight.
7. Power Metering:
- a. Factory installed, integrated within switchboard.
 - b. BACNET MS/TP connectivity.
8. Surge protection:
- a. Factory installed, integrated within switchboard.
9. Additional Features
- a. Factory finish gray paint application.
 - b. Commercial channel base.

C. EXECUTION

1. The switchboard(s) shall remain in the manufacturer's container(s) until such time that the unit(s) can be set and assembled. Once the equipment has been received at the job site, it shall be stored to prevent physical damage from weather or construction.
2. Provide a 4" thick concrete pad, 3000 psi with leveling channels in the floor construction for mounting of the switchboard.
3. The manufacturer's representatives shall inspect the equipment after installation and certify in writing to the Engineer that the equipment had been installed in accordance with the manufacturer's recommendations. In addition, the operation of all devices shall be checked by the manufacturer's representative in the presence of the Engineer.
4. Where the switchboard is specified with the Ground-Fault Protection of Equipment main breaker, testing of the ground fault protection system at the job site shall be performed by a qualified person(s) using primary current injection in accordance with the instructions provided with the equipment and in accordance with NEC 230.95(C). All readings shall be tabulated by the contractor. A written record of the testing shall be provided to the AHJ and the engineer of the record.
5. Upon completion of installation, and prior to final inspection, the contractor shall reduce in size the as-built riser diagram, frame same under glass and mount in a conspicuous place adjacent to the switchboard.
6. Switchboards identified for use as service equipment shall be labeled.

END OF SECTION 262413

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SECTION 262416 - PANEL BOARDS AND CIRCUIT BREAKERS

A. GENERAL

1. The Electrical Contractor shall provide all panelboards and circuit breakers as shown on the plans in accordance with this specification.
2. All equipment shall meet UL, NEC and NEMA Standards as applicable to the equipment specified herein.
3. All panelboards shall be equipped with a main circuit breaker or main lugs as indicated on the drawings.
4. All panelboards shall be equipped with branch breakers as shown on the drawings.
5. All panelboards identified on the drawings for use as service equipment shall be so labeled and UL listed for such use.
6. Full size insulated copper neutral bars shall be included in all panelboards. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
7. A copper ground bus shall be included in all panelboards.
8. All current-carrying parts of the bus assembly shall be copper with tin plating.
9. Panelboards shall be labeled with a UL short circuit rating not less than the rating indicated on the drawings.
10. The word "spare", unless noted otherwise on the panel schedules, shall be a single pole, 20 amp circuit breaker.
11. The word "space", unless noted otherwise on the panel schedules, shall be for a space in the panelboard for a standard size, single pole circuit breaker.
12. Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.
13. Sub fed breakers are not acceptable.
14. Series rated panel boards or breakers are not acceptable.
15. All NEMA 1 panel boards shall have a hinged trim (Door in Door).
16. All panelboards shall have breakers, terminals, and Lugs UL approved use with 75°C rated conductors.

B. PRODUCT

1. This section shall be for panelboards whose characteristics shall not exceed the following:

Voltage = 240	Maximum Branch Circuit = 125 amps
Amps = 600	Short Riding Circuit = 22,000 amps

- a. Panelboards shall be Square D Company type NQ (bolt- on) or equivalent by Siemens, Eaton, or ABB.
 - b. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
 - c. The panelboard bus assembly shall be enclosed in a steel cabinet. The size of the wiring gutters and gauge of steel shall be in accordance with NEMA, UL and National Electrical Code requirements for panelboards. The box shall be fabricated from galvanized steel or equivalent rust-resistant steel. Surface mounted cans shall be galvanized and without preformed knockouts.
 - d. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Door shall be mounted by completely concealed steel hinges. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door. Fronts shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.
 - e. Panelboard trims shall cover all live parts. Switching device handles shall be accessible.
2. This section shall be for panelboards whose characteristics shall note exceed the following:

Voltage = 480	Maximum Branch Circuit = 125 amps
Amps = 600	Short Circuit Rating = 65,000 amps 480 VAC = 100,000 amps 240 VAC

- a. Panelboards shall be Square D Company Type NF (bolt- on) or equivalent by Siemens, Eaton, or ABB.
- b. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type.
- c. The panelboard bus assembly shall be enclosed in a steel cabinet. The size of the wiring gutters and gauge of steel shall be in accordance with NEMA, UL and National Electrical Code requirements for panelboards. The box shall be fabricated from galvanized steel or equivalent rust-resistant steel. Surface mounted cans shall be galvanized and without preformed knockouts.

- d. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike. Door shall be mounted by completely concealed steel hinges. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door. Fronts shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.
 - e. Panelboard trims shall cover all live parts. Switching device handles shall be accessible
3. This section shall be for panelboards whose characteristics shall not exceed the following:

Voltage	= 480	Maximum Branch Circuit	= 1,200 amps
Amps	= 1,200	Short Riding Circuit	= 200,000 amps

- a. Panelboards shall be Square D Company, Type I-Line or equivalent by Siemens, Eaton, or ABB
- b. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel are to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with NEMA, UL and NEC Standards for panelboards. Cabinets are to be equipped with spring latch and tumbler-lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. End walls shall be removable. Fronts shall be of code gauge, full finished steel with rust inhibiting primer and baked enamel finish.
- c. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breaker shall be barriered on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall be barriered.
- d. A circuit directory frame with a clear plastic covering and a directory card shall be provided on the inside of the door.

4. Molded Case Circuit Breakers

- a. This specification covers molded case circuit breakers rated 15 through 1200 amperes 120VAC, 240VAC, 277VAC and 480VAC. Breakers covered under this specification may be installed in switchboards, panelboards, motor control centers, combination motor starters, busway plugs and individual enclosures.
- b. Circuit breakers shall be manufactured by Square D Company of the size as indicated on the drawings or equivalent by Siemens, Eaton or ABB. All breakers shall be bolt-on type.
- c. All circuit breakers shall have a quick-make, quick- break over center toggle type mechanism. The handle mechanism shall be trip-free to prevent holding contacts closed against a short circuit or sustained overload. All circuit breakers shall assume a position between on and off when tripped automatically. Multi- pole circuit breakers

shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Arc extinction is to be accomplished by magnetic arc chutes. All ratings shall be clearly visible.

- d. Automatic operation of all circuit breakers shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. Circuit breakers shall be calibrated to carry 100% rated current in an ambient of 40 degrees Celsius. Circuit breakers shall be ambient compensating in that, as the ambient temperature increases over 40 degrees Celsius, the circuit breaker automatically derates itself so as to better protect its associated conductor. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes 250 amps and above.
- e. The interrupting rating of each circuit breaker shall be as indicated on the drawings. The interrupting rating of the circuit breakers shall be at least equal to the available short circuit current at the line terminals of the circuit breaker and correspond to UL listed integrated short circuit current rating specified for the panelboards and switchboards.
- f. UL Class A (5 milliamperes sensitivity) ground fault circuit protection shall be provided on 120 V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional single pole circuit breaker.
- g. Motor starters, and other applications as indicated on drawings, shall be furnished with magnetic-only type molded case circuit breakers. Each breaker shall be provided with a single magnetic adjustment that will set all poles to the same trip current. Adjustment shall be continuous throughout the adjustable trip range. The magnetic trips shall be accessible from the front of these circuit breakers.

C. EXECUTION

- 1. Panelboards shall be flush or surface mounted as shown on the plans.
- 2. Panel enclosures shall not be used as junction or pull boxes for splicing conductors.
- 3. Each flush mounted panel shall be equipped with two empty one inch conduits sealed in the wall from a panel to a six inch square flush mounted box installed above a lay-in type ceiling or flush in the wall at the ceiling for a plaster or spline type acoustical tile ceiling.
- 4. All panels shall be equipped with neatly typed directory cards attached on the inside of the door.
- 5. GFI circuits shall be tested by the Contractor prior to the pre-final inspection.

6. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated by the contractor.
7. The number of branch circuit shall be identified with permanent wire tag attached to the wire.

END OF SECTION 262416

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SECTION 262419 - MOTOR CONTROL CENTER

A. GENERAL

1. DEFINITIONS

Motor control centers may also be identified as MCC.

2. SUBMITTAL

In addition to product submittal per section 260000, contractor shall submit control wiring diagram to meet the control requirements per plan to the engineer for approval.

B. PRODUCTS

1. Accepted manufacturers:

Motor control center shall be manufactured by the same manufacturer as the switchboard and panel board. Accepted manufacturers are Square D by Schneider Electric, Siemens, ABB and Eaton.

2. Motor Control Center Ratings/Configurations: As indicated on drawings.

3. Motor Control Center Assemblies:

a. Comply with NEMA ICS 18; listed and labeled as complying with UL 845.

b. Sections:

- 1) Provide Separately constructed structures, assembled to form rigid freestanding unit, braced to prevent distortion.
- 2) Construct vertical sections using welded side-frame assembly formed from minimum 12 gauge steel.
- 3) Use internal reinforcement structural parts made from 12 gauge and 14 gauge steel.
- 4) Include hardware and bussing to add or move units within each section for draw-out units.
- 5) Future Provisions: Prepare designated spaces for future installation of units.
- 6) Cover unused space with hinged blank doors.
- 7) Cover vertical bus openings with manual bus shutters.
- 8) Bolt sections together to form integrated rigid structure.

4. Short Circuit Current Rating: Where not specified, provide MCC with listed short circuit current rating not less than 42,000 amps.

5. Bus and Connector Material: Tin-plated copper.
6. Enclosures:
 - a. Construction: Steel.
 - b. UL 50E Rating, Unless Otherwise Indicated:
 - c. Indoor Clean, Dry Locations: Type 1.
 - d. Provide removable 7 gauge steel base channels with height of 1.5 inches (38 mm) under front and rear of vertical sections extending full width of shipping block.
 - e. Provide removable lifting angles with height of 3 inches (76 mm).
 - f. Provide single-piece or two-piece removable top plate on each section.
 - g. Standard Dimensions:
 - 1) Height: Maximum of 90 inches (2286 mm), not including base channel, lifting angle, baffle, or plenum.
 - 2) Width: Minimum section width of 20 inches (508 mm); available section widths of 25 inches (630 mm), 30 inches (760 mm), and 35 inches (890 mm).
7. Combination Starter unit: Each unit shall consist of
 - a. Breaker with rating as indicated on plan
 - b. NEMA rated contactors to match breaker rating.
 - c. Padlocking provision for one to three padlocks to lock the disconnect in the 'OFF' position and mechanical interlocks to prevent opening of the door unless the disconnect device is in 'OFF' position. This lock shall be defeatable.
 - d. Control Power Transformer (480V input, 120V output):
 - 1) Provide two primary protection fuses and one secondary fuse (in nonground secondary conductor).
 - 2) Size to accommodate contactor(s) and connected control circuit loads.
 - 3) Transformer rating to be visible from front when unit door is open.
 - e. All required control relay to achieved function per plan.
 - f. Control switches and indicator as follows:
 - 1) START-STOP - push button

- 2) POWER ON – Red pilot light
- 3) CONTACTOR ON – Green pilot light

g. Power Control Panels:

Contractor shall provide control panels as shown on plan. Control panels shall be with NEMA 1 enclosure for surface mounted installation. Label all switches and indicator light as required. See plan for requirements. Control switches and indicators shall be as follows:

- 1) ON push button - Green
- 2) OFF push button - Red
- 3) SYSTEM ON - Green pilot light
- 4) EMERGENCY SHUT DOWN- Red Mushroom Head with lock and key.

C. EXECUTION

1. EXAMINATION

- a. Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- b. Examine for conditions detrimental to completion of work.
 - 1) Verify location is nonhazardous, well-ventilated and free from humidity, dust, and dirt.
 - 2) Verify minimum clear installation space is provided.
 - i. Front: Minimum of 3 feet (914 mm).
 - ii. Rear:
 1. Front-of-Board Construction: Minimum of 0.5 inch (13 mm) from wall; 6 inches (152 mm) for damp locations.
 2. Back-to-Back Construction: Minimum of 3 feet (914 mm).
 - 3) Arc-Resistant MCCs:
 - i. Overhead: Minimum of 28.5 inches (724 mm).
- c. Verify concrete pads are level and free of irregularities; mounting surface made of noncombustible material if bottom plates are not installed in each vertical section.
- d. Verify mounting surface under MCC is made of noncombustible material unless bottom plates are installed in each vertical section.

2. INSTALLATION

- a. Install equipment in accordance with manufacturer's written instructions.
- b. Unless otherwise indicated, install and anchor MCCs on raised concrete pad 4" high.
- c. Provide a copy of control wiring diagram at each MCC in a sleeve attached to the MCC.

3. FIELD QUALITY CONTROL

- a. Operational Readiness Testing:
Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer's recommendations, and readiness for operation.
 - 1) Visually inspect for physical damage and proper installation.
 - 2) Perform tests in accordance with manufacturer's instructions.
 - 3) Perform tests to verify compliance with Contract Documents.
 - 4) Perform tests to verify equipment is ready for operation.
 - 5) Touch-up paint chips and scratches with manufacturer-supplied paint.

4. CLOSEOUT ACTIVITIES

- a. Functional Demonstration Testing: Demonstrate proper operation of motor control centers and associated systems to Owner's designated representative, Engineer and the state construction inspector, observing and documenting compliance with Contract Documents.
- b. Training:
 - 1) Train Owner's personnel on operation and maintenance of system.
 - i. Provide not less than one session with two hours of classroom and hands-on training.
 - ii. Instructor: Factory-trained manufacturer's representative.

5. PROTECTION

Protect installed motor control centers from subsequent construction operations.

END OF SECTION 262419

SECTION 262500 - TRACK BUSWAY SYSTEM

A. GENERAL

1. SUMMARY

This specification covers the electrical characteristics and general requirements for a track busway system, hereafter referred to as Track Busway. The system shall be designed primarily for overhead power distribution of electrical power. Once installed, the Track Busway will provide simple, versatile, fast and economic means of distributing power. Loads fed from Track Busway plug-in units can be added or removed without shutting down the busway.

2. STANDARDS AND CERTIFICATION

The Track Busway shall be designed and manufactured to the following standards:

- a. Electrical Testing Laboratories (ETL) (US/Canada) Certified to UL 857.
- b. National Electric Code (NEC) – Article 368 – Busways
- c. National Fire Protection Agency (NFPA) – 70, National Electric Code (NEC)
- d. National Electrical Manufacturers Association (NEMA) - AB1, Molded Case Circuit Breakers and Molded Case Switches (if applicable)

B. PRODUCTS

1. Track busway shall be manufactured by Starline by Legrand, Square D by Schneider Electric, ABB, Siemens and Eaton.
2. Electrical Requirements
 - a. System voltage: up to 600V
 - b. Frequency: 50/60 Hz.
 - c. Ampacity: 225
 - d. Neutral Ampacity: Minimum of 100% of rating
 - e. Short circuit rating must be: 22 kAIC up to 600V; 50 kAIC up to 240V, 65kAIC up to 480V
 - f. Conductors: 3 phase conductors, solid copper, tin plated
 - g. Grounding: 1 dedicated conductor solid copper, tin plated.
3. Track Busway Housing

- a. Extruded aluminum housing certified to serve as a 100% ground. Standard housing lengths are 5, 10 and 20 feet (1.5, 3 and 6 meters). 20 ft. (6 meter) maximum lengths can be cut in customizable lengths down to the inch or 3 centimeters. The housing should be properly extruded with a slot to receive rod mount hangers to hang from a ceiling. This housing should be open on the bottom to accept plug-in units anywhere along its length. This opening shall pass UL's hypothetical finger probe test.
 - b. All conductors shall be made of copper and sized to handle 100% of its rating continuously up to the maximum ambient temperature. The conductors shall be electrically isolated from the housing. All insulators must be UL and IEC compliant.
 - i. Ground conductor: An internal, 100% ground conductor is to be supplied if shown on the drawings
 - c. Track Busway housing sections shall be joined together by a 'press fit' that requires no bolted connection and no future maintenance
 - d. Track Busway housing shall be available in standard silver, red, blue, black, white or custom RAL colors
4. Power Feed
- a. The power feed shall provide the connections from the incoming cables to the Track Busway system. The power feed shall have internal connection to a section of busway conductors. End feeds, top feeds, center feeds and bottom feeds shall be available depending upon what Track Busway system is required. Feeds shall have the option to be designed with mechanical or compression type lugs.
5. Plug-In Units
- a. Plug-in units shall be polarized to avoid incorrect installation
 - b. Plug-in units can be added, removed or repositioned without de-energizing the busway
 - c. Plug-in units shall use either a circuit breaker or a fuse for branch circuit protection as shown in the schedule on the project drawings
 - d. Plug-in units shall be capable of being built with customer-specified circuit protection, outlets and accessories
 - e. Plug-in units shall not require any tools to mount to the busway
 - f. Plug-in units shall not have a mechanism in order to engage the electrical connection to the busway conductors
 - g. Plug-in units shall have locking clips or bolt-on tabs to secure units to the busway
 - h. Plug-in units that include drop cords shall be manufactured with cord grips and receptacles as specified in the drawings

- i. Plug-in units shall be configured by the manufacturer to balance the load based on quantity of plug-in unit types provided
 - j. Plug-in units shall have the ability to provide up to a 400 amp load in certain plug-in unit configurations
 - k. Plug-in units shall have a minimum of 10kAIC and the ability to obtain a maximum of 200kAIC
 - l. Plug-in units shall be interchangeable within each Track Busway series.
6. Operating stick
- a. Operating stick shall allow to operate the fuse disconnect up to 20 ft. from floor level.
 - b. Furnish 2 as required.

C. EXECUTION

1. INSTALLATION

- a. The contractor shall install Track Busway in accordance with the manufacturer's instructions.
- b. Track Busway runs shall consist of lengths as shown on the drawings.
- c. The plug-in unit orientation shall be indicated on the drawings.
- d. Hanging of the Busway: The Track Busway shall be hung from a structure above the busway, using the supplied busway hangers. The hangers shall connect to the busway, and to an all thread rod provided by the installing contractor. The spacing of the hangers along the busway is 10 feet (3 meters).
- e. The busway shall be installed with the open access channel facing downward, or to the side for special applications. Special installation shall be agreed upon by the manufacturer.
- f. Connecting Sections of Track Busway: At a junction of Track Busway sections, the installer will use a Joint Kit (includes Housing Couplers and Bus Connector) and an Installation Tool supplied by the manufacturer. Two sections are joined together by a 'press fit' that requires no bolted connection and no future maintenance.
- g. End of Runs: End caps will be provided to install at the end of each run.
- h. Closure Strip: The closure strip is an optional accessory that can be cut and fitted to cover the bottom opening of the Track Busway housing to prevent dust and debris. Closure Strip can be field modified for fit.
- i. All Track Busway joints are non-bolted, compression fit and shall require no maintenance after installation

2. FIELD QUALITY CONTROL

- a. Manufacturers Field Services: Track Busway shall be accompanied by optional services, such as on-site support and system startup, ongoing support, metering services and extended warranty programs. These services include:
- 1) On-site Training
 - 2) Installation Inspection, Commissioning and Certification
 - 3) Includes comprehensive visual inspection and certified report once results are satisfactory, which extends standard factory warranty from one to two years
 - 4) IR Scanning and other Ongoing Support
 - 5) Extended Warranty Programs (Meter programming, commissioning and support)
 - 6) Emergency Service and Phone Support

3. DOCUMENTATION

- a. The following documentation shall be available to assist in product selection and installation, and is available for download at <http://downloads.uecorp.com/>:
- 1) Track Busway Product Selection Guide
 - 2) Operation, Installation and Maintenance Manuals
 - 3) Installation Instructions
- b. Product drawings shall be rendered and provided at the time of ordering

END OF SECTION 262500

SECTION 262726 - WIRING DEVICES

A. GENERAL

1. Switches, dimmer switches, photocell, contactors and receptacles, with proper cover plates, shall be provided where indicated on the Drawings.

B. PRODUCT

1. Switches, dimmer switches, photocell, contactors and receptacles shall be as specified in the Symbol Schedule of the Drawings.
2. All switches and receptacles shall be federal specification grade meeting NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL-498 and shall be approved third-party listed.
3. Switches and receptacles shall be as manufactured by Hubbell, Pass and Seymour, Leviton or Eaton. Photocells shall be manufactured by Tork, Paragon, Bryant, or equivalent.
4. Cover plates for all wall mounted devices shall be provided as scheduled on the Drawings. Where covers are not specified, they shall be as follow:
 - a. Interior: type 302 stainless steel. Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate, and shall be furnished with the plate by the plate manufacturer.
 - b. Exterior, exposed work and wet locations: cover plates shall be extra-duty rated (NEC 406.9(B)(1)) galvanized cast ferrous metal, standard size, and shall be single or ganged as indicated on the drawings. Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof cover plates, standard size, single or ganged as indicated on the drawings, and shall be "approved" third party listed as "rain-tight while in use."
5. All devices shall have a hex-head green grounding screw for use in connecting device to green grounding conductor run in the conduit system.
6. All GFI devices shall be the feed through type.
7. All standard duplex receptacles shall be 20 amp, 125 volt rated.
8. All devices subject to use in a wet location shall be listed as weather resistant.
9. All switches shall be rated 20 amp, 120/277 volt. Toggle switches shall have quiet operating mechanisms without the use of mercury switches.

C. EXECUTION

1. Mounting height shall be as indicated on the Drawings. Coordinate with other trades so that devices will miss equipment installed by others.
2. Where two or more devices are ganged, they shall be in a common box with a ganged plate.
3. All devices shall have a green ground conductor to run parallel with the phase conductor back to the electrical panel.
4. In all areas where carpet is to be installed as finished floor material, unless otherwise specified, the Electrical Contractor will furnish solid brass carpet flanges for installation on floor outlet boxes. Flanges will be furnished and installed on all active outlets after the carpet is installed. Where a specified number of outlet fittings are to be furnished to the Owner, for each fitting not installed during the construction period, it will be turned over to the Owner with the receptacle, carpet flange and all necessary appurtenances.
5. Provide quantity of 2% spare cover plates of each type to the owner.

END OF SECTION 262726

SECTION 262727 - DISCONNECTS

A. GENERAL

1. Disconnect switches shall be provided where indicated on the drawings, or as required by the National Electrical Code (NEC).

B. PRODUCT

1. Disconnects shall be heavy duty as manufactured by Square D Company, Siemens, Eaton or ABB.
2. Disconnects shall be furnished with factory finish paint and appropriate knockouts for conduit connections.
3. All disconnects shall have side hinged type doors. Front operated handles will not be permitted.
4. All fused disconnects shall be equipped with positive pressure fuse clips and shall have visible disconnecting blade switches.
5. NEMA 1 enclosures shall be provided where installed indoors. NEMA 3R enclosures shall be provided where exposed to the elements, unless noted otherwise.
6. All disconnects shall have copper bus.
7. Disconnects shall have provisions for locking in on and off positions.
8. Disconnects shall have defeatable door interlocks that prevent the door from opening when the operating handles is in the "on" position.
9. Disconnects shall have handles whose positions are easily recognizable in the "on" or "off" position. For safety reasons, padlock shall be provided for switches located in the public areas.

C. EXECUTION

1. Disconnect switches shall be mounted as indicated on the Drawings and shall be independently supported. Conduits entering the disconnect switch shall not be used to support switches.
2. Where fused disconnect switches are required or shown on the plans, standard fuses shall be used unless the switch protects an individual motor circuit, then dual element fuses shall be used.
3. The electrical contractor shall provide to the owner the spare fuses, 10% of the quantity of fuses used of each type and rating, with a minimum of one set of each type.

END OF SECTION 262727

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SECTION 265100 - LIGHTING FIXTURES

A. GENERAL

1. The Contractor shall provide all fixtures and lamps where indicated on the Drawings.
2. Work shall include all stems, canopies and accessories necessary for a complete lighting fixture installation.
3. No PCB ballasts shall be accepted.
4. All lighting systems shall comply with the 2018 North Carolina State Energy Code and North Carolina Senate Bill 1946 and G.S. 143-64.17.

B. PRODUCT

1. Fixtures shall be as specified in the Fixture Schedule on the Drawings or approved equivalents.
2. All outdoor fixtures shall bear the approved third party test label for damp or wet locations as applicable. Where the ambient falls below 50°F that all fluorescent lamps and ballasts shall be rated for operation at 0°F.
3. Unless otherwise noted, all fixtures shall be new, free of defects and imperfections. Damaged fixtures shall be replaced at this Contractor's expense.
4. All acrylic lenses for lay-in troffers and wrap around fixtures shall have a nominal lens thickness of 0.125" unless noted otherwise on plans.
5. LED Luminaries:
 - a. LED driver manufacturers should have a minimum of five years of experience with the manufacture of LED drivers. All drivers shall have a minimum warranty of five years.
 - b. Where dimming is required, fixtures shall be dimmable down to 1% with standard 120/277 volt, electronic, low voltage dimmers.
 - c. Minimum color rendering index (CRI) shall be 80. Color temperature and performance shall conform to the parameters established by ENERGY STAR SSL standards (refer to ANSI-C78.377-2008).
 - d. Optical design shall be low glare, 50% cut-off.
 - e. Rated for 50,000 hours at 70% lumen maintenance.
 - f. LED driver shall be high efficiency with a minimum power factor of .90
 - g. 5 year, 100% warranty coverage for the driver, LED module, housing and trim. For the 1st year this shall be a complete parts and labor warranty. The 4th and 5th years shall cover parts only.
 - h. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)

- i. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV for interior fixtures.
 - j. Sound: Class A not to exceed a measured value of 24dB.
 - k. Maximum standby power: 1W
 - l. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
6. Emergency Exit Lights per the State Construction Office requirements.

It shall be completely self-contained, provided with maintenance-free battery, automatic charger, and other features. Luminaire must be third-party listed as emergency lighting equipment, and meet or exceed the following standards; NEC, N.C. Building Code, Energy Code, NFPA-101, and NEMA Standards.

a. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.

b. Charger

It shall be fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80 percent. A low voltage disconnect switch shall be included if LEAD Battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.

c. Additional Features

Pilot light to indicate the unit is connected to AC power. The battery shall have high rate charge pilot light, unless self-diagnostic type. A test switch to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. This simulation must also exercise the transfer rely.

d. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.

e. LED

The use of LED is required due to their reliable performance, low power consumption, and limited maintenance requirements. Maximum LED failure rate shall be 25% within a seven (7) year period; otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the owner.

f. Unit Test

Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes, in accordance with NEC 700. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced, and tested again. Copy of the test report shall be included with the project record documentation.

7. Emergency Lights per the State Construction Office requirements

Shall be completely self-contained, provided with maintenance-free 12 volt battery, automatic charger, two lamps and other features. Fixture shall be third party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, N.C. Building Code, UL 924, NC Energy Code, NFPA-101, and NEMA Standards.

a. Additional Features

Pilot light to indicate the unit is connected to AC power. The battery shall have high rate charge pilot light, unless self-diagnostic type. A test switch to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. This simulation must also exercise the transfer rely. If fluorescent emergency unit is used, a LED charging indicator light must be easily visible after installation and a remote test switch shall be installed adjacent to the fixture.

b. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degrees C to 60 degrees C and contain a resealable pressure vent, a sintered + positive and -negative terminal.

c. Charger

It shall be fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80%. A low voltage disconnect switch shall be included in LEAD battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.

d. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contact document.

e. Unit Test

Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes, in accordance with NEC 700. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced, and tested again. Copy of the test report shall be included with the project record documentation.

8. Emergency Power Backup unit.

The unit is used for controlling designated light fixtures as shown on plan to be used as emergency light. The unit shall have rating as shown on plan. Unit shall be third party listed as emergency power backup unit for emergency light, and meet or exceed the following standards: NEC, N.C. Building Code, UL 924, NC Energy Code, NFPA-101, and NEMA Standards.

a. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.

b. Output characteristic.

It shall provide 60Hz sinusoidal waveform output and compatible with LED and fluorescent light fixtures. Transfer time shall be less than 1 second.

c. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contact document.

C. EXECUTION

1. All fixtures shall be installed in accordance with the National Electric Code.
2. All fixtures other than the lay-in type shall be individually supported from building structure with 1/4" threaded rods and nuts.
3. Where a recessed or downlight fixture replaces a section or part of a ceiling tile, fixture is to be supported at the two (2) opposite ends to the steel frame of the building. 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 luminaire and the other end to the building's structural system. The lay-in luminaire shall then be screwed to the main runners of the lay-in ceiling track at all four (4) corners using sheet metal screws. For fire rated suspended ceiling, luminaire shall be supported to the Building Structure as per the Ceiling Design Criteria, luminaire shall then be screwed to the main runners of the suspended ceiling track at all four (4) corners using sheet metal screws.
4. The complete emergency lighting system shall be tested by throwing the circuit breakers feeding the emergency lighting circuits. One and one-half hours thereafter, the battery voltages shall be recorded in a report to be submitted to the Engineer. This test shall be performed just prior to final inspection, under witness of the state electrical inspector, and in accordance with NEC Articles 700.4 (A) and (D).

END OF SECTION 265100

SECTION 270000 - TELECOMMUNICAITON DISTRIBUTION SYSTEM

A. GENERAL

1. RELATED DOCUMENTS

- a. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all other Specification Sections, apply to this Section.
- b. The Contractor shall provide the required protection in accordance with the requirements of these specifications and NEC 2020, Article 800. The protection shall be provided on both ends of all inter-building cables where required by code or otherwise indicated in the contract documents (i.e., building-to-building, building-to-modular classroom, or building-to-modular complex).

2. SUMMARY

- a. This Section includes a Telecommunications Distribution System which is ready for the installation of active electronic equipment such as hubs, routers, bridges, switches, repeaters, adapters, etc. The system shall incorporate all requirements of this specification.

3. CONTRACTOR DELIVERABLES

- a. The contractor will need to coordinate the installation of the telecommunications cabling with the general contractor. Cable shall not be installed until the building is secured.
- b. The Contractor shall prepare and provide two (2) copies of the following documentation for review and approval by the Engineer:
 - 1) A labeled cable plant drawing.
 - 2) Work Area Floor Plans - Include detailed cable routes and labeling plan for all work areas. The Contractor may obtain floor plans from the Architect in AutoCAD format, if so desired, to aid in preparing the submittal.
 - 3) Upon completion of the project, the Contractor shall prepare "As-Built" documentation showing actual site conditions and installation as constructed, and provide copies of such documentation as per paragraph A.3.b.
 - 4) In addition to the engineering diagrams, the following items shall be provided by the Contractor at substantial completion:
 - 1) Laminated cable schedule, sized 8-1/2 "x 11".
 - 2) Record of field tests of System
 - The data TCO identification numbers in recording test results shall be the same as those shown on the "As-Built" and cable schedules.
 - 5) Technical Support Staff and Experience

- 1) The Contractor shall provide a list of its project management staff and technical support staff to be assigned to this project together with their resumes and working experience.
- 2) The Contractor shall utilize certified cable installers and technicians with approved vendor specific certification. The Contractor shall supply certification documentation for cable installers.
- 3) The Contractor shall state their nearest branch office and dealer's office in relation to the proposed site of the cabling system. If none, the location of the main office shall be stated.
- 4) The Contractor shall state their nearest location of their principal support center. This center shall have permanently stationed support staff that is capable of providing technical support if required.
- 6) System Warranty
 - 1) The Contractor shall provide a five- (5) year warranty for both products and labor.
 - 2) Service must be provided within twenty-four (24) hours of notification for emergency situations and within seventy-two (72) hours for routine service.

4. PRODUCT SUBMITTALS

- a. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
 - 1) Product data for system components

5. QUALITY ASSURANCE

- a. Comply as applicable with ANSI/TIA/EIA-568-B.1, ANSI/TIA/EIA-568-B.2, and ANSI/TIA/EIA-568-B.3 "Commercial Building Telecommunications Cabling Standard," most recent addition.
- b. Comply as applicable with ANSI/TIA/EIA-569-A, "Commercial Building Standards for Telecommunications Pathways and Spaces," most recent addition.
- c. Comply as applicable with ANSI/TIA/EIA-606, "The Administration Standard for Telecommunications Infrastructure of Commercial Buildings," most recent addition.
- d. Comply with NFPA 70, "National Electrical Code," 2020.
- e. NC STS-1000 Telecommunications Wiring Guidelines.
- f. "Nationally Recognized Testing Laboratory" (NRTL) Listing: Provide materials that are listed and labeled.

- 1) The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
- 2) Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- 3) FCC Regulations: Comply with FCC Part 68, Chapter 1, "US Code of Federal Regulations," Title 47 for all telephone system wire and cable connection components.

B. PRODUCTS

1. BACKBONE CABLE: Contractor shall provide all backbone cable inside building.

a. FIBER OPTIC CABLE

- 1) All cables shall conform to or exceed the TIA/EIA-568-B.3 Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling Components Standard.
- 2) The multi core optical fiber shall consist of multimode 50 micron fibers, OM4.
- 3) The fiber cable shall meet the NEC requirements for OFN, OFNR or OFNP and comply with Bellcore, FDDI, TIA/EIA-568-B.3 and ICEA standards.
- 4) Connectors shall be crimp-on type, pre-polished SC connectors or hot melt.
- 5) Cable shall be rated for indoor/outdoor and wet location.

b. CATEGORY 3 COPPER VOICE

- 1) Contractor shall supply unshielded 24 AWG solid conductor multi-pair copper cables as the backbone cables.
- 2) The cable shall meet or exceed the TIA/EIA-568-B.2 "Commercial Building Telecommunications Cabling Standard" - Part 2: Balanced Twisted Pair Cabling Components.
- 3) The PVC sheath shall have improved frictional properties, allowing it to be pulled through conduit without the use of lubricants.
- 4) The cable shall be available in the form of twenty-five (25), fifty (50), one hundred (100), one hundred fifty (150), and two hundred (200) pairs.
- 5) Cable shall be rated for outdoor and wet location.

2. HORIZONTAL CABLE: Contractor shall provide all horizontal cables.

a. CATEGORY CABLE (CAT6A)

- 1) All cables shall conform to or exceed the TIA/EIA-568 C.2

- 2) Other standards supported include IEEE 802.3, 10BASE-T, and ANSI X3T9.5 TP-PMD requirements for UTP at 100 Mbps.
 - 3) Cables shall be capable of supporting evolving high-end applications such as 1000 Mbps ATM. All cables shall be composed of 4-pair 23 AWG solid copper conductors.
 - 4) The cable shall be Underwriter's Laboratories Inc. (UL) listed type MPR, MPP, CMR, and CMP.
 - 5) Cable shall be plenum rated.
3. TELECOMMUNICATIONS OUTLET (TCO)
- a. Shall be modular, RJ45 type/8 position/8 conductor.
 - b. Shall be universal application/multivendor supportive accepting most phone and data plugs.
 - c. Modular connectors shall be flush with outlet faceplate.
 - d. Cover to match those indicated for power receptacle outlets in same spaces for materials and finish.
 - e. Outlets shall be wired in an EIA/TIA 568B configuration.
 - f. All outlets shall be listed for CAT6A application and utilize cross-over lead technology to address data circuit applications up to 100 MHz and conform to or exceed the EIA/TIA 568-C Commercial Building Telecommunications Wiring Standard and the following:

4. PATCH PANEL

- a. FIBER OPTIC PATCH PANEL
 - 1) The panel shall support shall be with SC connectors.
- b. CAT6A PATCH PANEL
 - 1) The panel shall support the Category 6A applications and facilitate cross-connection and inter-connection using patch cords.
 - 2) The wiring blocks shall be fire-retardant, molded plastic consisting of horizontal index strips for terminating conductors. These index strips shall be marked with four colors on the high teeth, separating the tip and ring of each pair, to establish pair location.
 - 3) The panel shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10000 connections.

- 4) 19" rack mountable patch panels shall be used. Patch panel installations shall contain a retaining trough between every 100 pair termination block.
 - 5) The panel shall be able to accommodate 23 AWG cable conductors.
 - 6) The panel shall be Underwriter's Laboratories (UL) listed.
 - 7) Shall be wired in an EIA/TIA 568B configuration.
 - 8) All Category 6A patch panels shall support 100 Mbps TP-PMD and 155 Mbps ATM. All hardware shall meet or exceed the reliability, attenuation, and NEXT requirements of EIA/TIA 568A-5.
5. 19 INCH FREE STANDING RACK
- a. Hubbell HPW84RR19 or equal.
 - b. Provide 2 post cable management rack. The rack must provide a space on both sides for cable management.
 - 1) Front Horizontal wire management: Panduit CNMPHh2 or equal.
 - 2) Rear Horizontal wire management: Panduit WMPHF2E or equal
 - 3) Wire management bracket: OCC VCM6 or equal.
 - c. Unit to be open steel configuration. Unit shall be heavy-duty construction and be mounted on floor.
 - d. Unit to be self-supporting.
 - e. Unit to be fully compatible with EIA 1 ¼" – ½" alternating hole patterns.
 - f. Provide clear finish over surface to inhibit oxidation.
 - g. Unit to be with one power strip. Tripp Lite power strip/surge with minimum of 15 ft. cord and LED ampere indicator. Power strip/surge protectors shall be delivered to the ITS project manager.
6. CABLE TRAY:
- a. Cable tray shall be tubular stringer style B-LINE: SB-17 or equal.
 - b. With of tray shall be 12".
7. TERMINATION LABELS
- a. Shall conform to ANSI/TIA/EIA-606. Labels will have pressure sensitive, permanent acrylic type adhesive, P-Touch type weather proof or equal.

C. EXECUTION

1. GENERAL REQUIREMENTS

- a. The Contractor shall maintain conductor polarity (tip and ring) identification at the MDF and station connecting blocks in accordance with industry practices.
- b. The Contractor shall provide all cables. All communication cable installed by the Contractor shall be fully tested in accordance with TIA-568-C series standard prior to acceptance.
- c. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wiring duct (MDF & IDF locations), miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the System in a neat and orderly fashion as approved by the Engineer.
- d. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System. This may include, but is not limited to, tools for terminating cables, testing and splicing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable winches.
- e. The Contractor shall be responsible for printed labels for all cables and cords to the specifications. No labels are to be written by hand including numbers on boots. Approval must be obtained from the engineer for labeling devices used.
- f. The Contractor shall not place or attach any telecommunications cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
- g. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
- h. The Contractor shall be responsible for providing an approved ground at all newly installed distribution frames, and insuring proper bonding. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes and framework. All grounds and bonding shall consist of green #6 AWG solid copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground.
- i. The Contractor shall furnish to the Owner all closeout documentation in a three-ring binder with proper labeling on cover and the end of the binder.

2. INSTALLATION, GENERAL

- a. Distribution System: The contractor is responsible for the back to the new communications closet.
 - b. Raceway: Install service and distribution raceway for all cabling as indicated.
 - c. Conduit sleeves for Computer Network Infrastructure shall be installed not more than four inches (4") from wall and shall be stubbed at a maximum of four inches (4") above or below finished floor. Plastic bushings and pull wires shall be provided.
3. HORIZONTAL CABLE INSTALLATION

- a. Obtain approval of all raceway system installation from engineer prior to installing any cable. Install cable without damaging conductors or jacket. Do not bend cable to a smaller radius than minimum recommended by manufacturer. Do not exceed manufacturers recommended pulling tensions. Pull cables simultaneously where more than one is being installed in the same raceway or at the same location. Use pulling compound or lubricant where necessary. Compound used must not damage conductor or insulation. Use pulling methods that will not damage cable or raceway, including fish tape, cable, rope and wire-cable grips.

- b. Wiring Method

- 1) New Construction: Install outlet boxes at outlets. Install cable in raceway in wall. Terminate raceway with a bushing in ceiling space above nearest cable tray. Run cable in cable tray in accessible ceiling space.
- 2) Provide bushings on all conduits stubbed to ceiling void.
- 3) Copper Cable above finished ceilings: Install parallel or perpendicular to surfaces or exposed structural members and follow surface contours where possible. Install cables in approved supports on walls, not diagonally across ceiling void. All cables shall be routed and supported around the exterior walls of the room in a consistent pattern, with all break-outs being 90-degree angled turns without any corners being cut.

- i. Cable Support: Secure cable to independent supports at intervals as required by current industry standards, that prevents sagging between supports. Use metallic supports with corrosion resistant finish. Please provide separate cable pathways for all Technology related cabling and all other low voltage cabling.

- ii. Splices: Do not splice any cable between the normal terminations of runs.

- iii. No Dropped Ceiling: Route in conduit along structure. Min. conduit size is $\frac{3}{4}$ ".

- iv. Attach cable to building structure only as per NEC-800 Refer to Current Release Available.

- v. Technology related cables installed in cable tray shall be separated from all other low voltage cabling by dividing the tray into two distinct sections.

- vi. Technology related cabling installed in “J” type hooks” shall be separated from all other installed low voltage cabling. This means a separate installed “J” type hook pathway should be provided for all non-technology related low voltage cabling.
- 4) In suspended ceiling and raised floor areas where walker duct, cable trays or conduit are not available, the Contractor shall bundle horizontal Cat6 wiring with wire ties at appropriate distances. The cable bundling shall be supported via Cat6 "J" type hooks or Cat6 bridle rings with saddles attached to the existing building structure and framework. Adhering to industry standards concerning cable fill capacity for cable type being utilized. Use of Velcro straps is prohibited.
- c. The 4-pair UTP cables shall be installed using a star topology format from the administration subsystem on each floor to every individual TCO.
 - d. The length of any horizontal Cat 6A cable shall not exceed 295-ft (90 m).
 - e. Conduit installed by the Contractor should not exceed one hundred feet (100') or contain more than two (2) ninety degree (90°) degree bends without utilizing appropriately sized pull boxes.
 - f. No Condulets may be used.
 - g. Cabling in Telecommunications Sub closets and Cabinets: Install conductors parallel to and at right angles to walls. Bundle, lace and train the conductors to terminal points with no excess. Use wire distribution spools at points where cables are fanned or conductors turned. Connect conductors that are terminated, spliced or interrupted to terminal blocks.
 - h. Conductor Terminations: Terminate conductors of cables on terminal block using tools recommended by terminal block manufacturer.
4. TELECOMMUNICATION OUTLET (TCO)
- a. Unless otherwise noted on the floor plans, the TCO shall be flush mounted.
 - b. Outlet jacks shall be color keyed blue for data.
 - c. Wireless Access Point and Camera drops shall be installed as shown on plan with a minimum twenty (20') service loop in ceiling areas containing acoustical ceiling tiles and terminated on an RJ45 keystone style jack enclosed in a surface mount style box installed in and extended to the patch panel in the nearest designated IDF closet. Each biscuit jack installed shall be labeled with the complete label designation for that individual cable drop on the outside cover of biscuit jack and on adjacent ceiling grid.
5. FEEDER CABLE
- a. Contractor shall obtain approval of all raceway systems installation from the engineer prior to installing any cable.

- b. All fibers shall be installed in raceway (inner duct or armored fiber) and terminated with approved pre-polished, crimp-on SC-style connectors or hot melts at termination or distribution enclosures or at termination shelves equipped with sufficient panels, adapters and jumper storage to terminate and secure all fibers.
 - c. The fiber cable shall be protected by optical fiber raceway or appropriate apparatus at all times. Each end of the fiber cable shall contain a slack storage box with approximately six feet (6') of cable slack.
 - d. All copper voice feeder cable shall be terminated in a one (1) pair per port configuration. The feeder cable shall be terminated on the WHT/BLU and BLU/WHT connector of the Cat6 patch panel.
6. OUTSIDE CABLE
- a. All buried cable shall be contained in a raceway system. When using PVC, a metallic locating tape shall be installed twelve inches (12") below grade.
 - b. Contractor shall obtain approval of all raceway system installation from the engineer prior to installing any cable.
 - c. Provide hand holes on all underground inner building (between buildings) conduit runs that change direction.
 - d. Contractor shall provide electrical lightning/surge protection panels and protector units on copper cables that will prevent electrical surges on the cable from entering buildings.
 - e. It shall be the responsibility of the Contractor to stake all areas along the cable route forty eight (48) hours prior to any trenching or digging.
 - f. The Contractor shall be responsible for restoring any disturbed earth to its original condition. A reasonable effort shall include any landscaping, seeding, or replacement of shrubbery that may be required to properly restore the excavated area. If settling should occur, the installation Contractor shall be responsible for any secondary restoration.
7. GROUNDING
- a. Communications Systems - In compliance with NEC 2020, Article 800.
 - 1) See plan for detail.
 - b. Contractor shall install a copper busbar at the new telecommunication board for grounding of communication systems.
8. IDENTIFICATION
- a. Provide identification in accordance with the recommendations of ANSI/TIA/EIA-606-B, "Administration Standard for Telecommunications Infrastructure." Refer to labeling descriptions below.

- b. Contractor shall field verify labeling scheme with Pitt Community College IT department for the requirements. Submit the labeling schedule to Pitt Community College IT department for approval prior to making the labels.

9. FIELD QUALITY CONTROL

- a. Test Notice: Provide at least 10 days' notice in writing when the system is ready for final acceptance testing.
- b. Acceptance Tests: Include the following for each pair or conductor of each cable run.
 - 1) 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.
 - 2) Data horizontal wiring pairs shall be tested from the TCO to the patch panel or block, the basic link test.
- c. Data cables shall be tested for conformance to the specifications of TIA/EIA -568-B.2.10 for Cat6a copper cable.
 - 1) Wire Mapping shall be done to ensure proper wiring and connectivity. Test for:
 - Continuity, end-to-end.
 - Shorts between any two or more conductors.
 - Crossed pairs
 - Reversed pairs
 - Split pairs
 - Other mis-wirings
 - Document as Pass / Fail
 - 2) Length shall be measured. Indicate the length of the cable as the pair with the shortest length and record it
 - 3) Attenuation shall be tested with a remote signal injector and a reading made at the local end. Evaluate the worst pair attenuation and record result on test report.
 - 4) Bi-Directional NEXT. Near-end crosstalk (NEXT) shall be tested on all six pair combinations in each four pair cable. Tests for NEXT shall be performed from both the work area outlet location and link origination point.
 - 5) Computer generated test results must be submitted to the Architect.
 - 6) Re-testing: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify that the total system meets the Specifications and complies with applicable standards.

- 7) Report of Tests and Inspections: Prepare a written record of inspections, tests, and detailed test results in the form of a test log and format the log in cable ID number order.

END OF SECTION 271000

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SECTION 283100 - ADDRESSABLE FIRE ALARM SYSTEM

A. GENERAL

1. This document includes the furnishing, installation, and connection of the microprocessor controlled; intelligent reporting fire alarm equipment required to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring.
2. The fire alarm system shall comply with applicable provisions of the NC Building Code, NFPA 70 - National Electrical Code (NEC), NC Fire Code, and NFPA 72 -National Fire Alarm and Signaling Code. The Contractor shall furnish all parts, materials, and labor customarily required or provided for a complete and operating system, in accordance with all requirements applicable, even if each needed item is not specifically shown or described in the project plans or specifications.
3. Systems are to be provided with a separate and independent source of secondary power. All systems that report to a Central or Remote Supervising Station shall have a minimum of 24 hours battery power capacity, plus 5 minutes of full alarm load.
4. QUALITY ASSURANCE
 - a. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems of types, sizes, and electrical characteristics required, and whose products are Listed and Labeled. Products of firms that do not maintain factory authorized service organization and spare parts stock are not acceptable for use
 - b. Acceptable Manufacturers: Simplex, EST, Siemens, FireLite, Notifier or other approved equivalents.
 - c. Installer's Qualifications: Company specializing in performing the work and making the final terminations and connections. Minimum of 5 years documented experience installing fire detection and alarm systems similar in size and scope to the project. Only the Installer may make program changes and must be present for the 100% test, Designer's pre-final review and Owner inspections.
 - d. All connections to the FACP and the system's programming shall be done only by the manufacturer, or by an authorized distributor that stocks a full complement of spare parts for the system. The technicians are required to be trained and individually certified by the manufacturer, for the FACP model/series being installed. This training and certification must have occurred within the most recent 24 months, except that a NICET Level III certification will extend this to 36 months. Copies of the certifications must be part of the Shop Drawing submittal to the Designers, prior to installation. The submittal cannot be approved without this information.
 - e. The person that programmed the system must be present for the Engineer's (and State Construction Office, as applicable for state projects) final inspection.
 - f. NFPA Compliance: Comply with applicable requirements of NFPA-72, National Fire Alarm and Signaling Code.

- g. NEC Compliance: Comply with applicable requirements of NFPA-70, National Electrical Code (NEC) standards pertaining to fire alarm systems.
 - h. Comply with applicable requirements of NC Building Code and NC Fire Code.
 - i. Testing Laboratory Compliance: Comply with provisions of UL safety standards pertaining to fire alarm systems. Provide products and components which are Listed and Labeled.
 - j. FM Compliance: Provide fire alarm systems and accessories which are FM approved.
5. Definitions:
- a. Authority Having Jurisdiction (AHJ).
 - 1) The AHJ for code compliance is the town of Winterville Fire Marshal. The contractor shall field coordinate all permits and site inspections with the AHJ.
 - b. Fire Alarm Control Panel (FACP) - Also called a Fire Alarm Control Unit (FACU) by some entities. See requirements in Part B.
 - c. Remote Annunciator (FAA) – Provides LCD display with a text statement of the panel status and/or LED lamps to indicate the status of the fire alarm system. It is provided to assist fire fighters who respond to a call and to assist technicians who respond to a trouble condition.
 - d. Graphic Annunciator (GA) – Used to provide information regarding the status of detection, sprinkler and supervisor devices by zone and or floor of the building.
6. Submittals
- a. Submittals shall address interface with other significant electrical subsystems (e.g. electrically controlled smoke dampers, door holders, smoke evacuation and smoke control systems, security lock door hardware, etc.).
 - b. Shop Drawings:
 - 1) The fire alarm contractor shall submit complete Shop Drawings to the engineer for review, prior to performing any work. They shall clearly demonstrate compliance with the engineer's plans and specifications, which have a System Response Matrix showing the fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal. Any non-compliant features must be fully described. Shop drawing submittals shall provide mA draw for each device submitted and the listed minimum voltage required to operate. Panel submittal shall list voltage drop allowed for panel and for individual NAC circuits.
 - 2) The submitted shop drawings shall show equipment, device identification numbers and locations, and connecting wiring of entire fire alarm system. Include wiring and riser diagrams. Wiring diagrams shall be based on the project floor plans, with devices and proposed conduit routing. The conductor composition for each conduit section shall be provided. The distance and route for each NAC (Notification Appliance Circuit) shall be shown. Riser diagrams

shall show consecutive connections for all devices with addresses and candela and Candela ratings.

- 3) Engineer's approval (with or without corrections) of contractor's Shop Drawings, samples, cut sheets, etc., is for general conformance with the contract documents and design concept. It shall not relieve the contractor of responsibility for full compliance with the project plans and specifications, EXCEPT for any specific non-compliant features for which the engineer gives written authorization.
- 4) Installation Instructions: The contractor shall submit to the engineer of record the Manufacturer's detailed installation instruction for the Fire Alarm Control Panel and all duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
- 5) Battery and Voltage Drop Calculations:
 - i. Include a copy of system battery sizing calculations with the shop drawing submittal to the engineer. Use manufacturer's battery discharge curve to determine expected battery voltage after 60 hours of providing standby power. Then use calculated Notification Appliance Circuit current draw in the alarm mode to determine expected voltage drop at End of the Line Resistor (EOL), based on conductor resistance per conductor manufacturer's data sheet or NEC.
 - ii. Fire Alarm Vendor's calculations must be submitted with the shop drawings, and prior to installation of equipment. (Buildings without generators require minimum 60 hours of battery backup to cover the weekends and major power outages. Buildings with generators require minimum 24-hour battery backup.) In the submittal package identify Notification Appliance Circuits (NAC) current draws and voltage drops for each circuit. Vendor must utilize the "end offline" method for voltage drop calculations. The "mid-point" method is not acceptable. In no case shall the calculated voltage at any notification appliance fall below the minimum listed operating voltage for the devices used.
 - iii. The voltage drop at EOL must not exceed 14% of the expected battery voltage, after the required standby time plus alarm time. (Typically, for a 24-volt system, this limits the voltage drop from the battery to the EOL to 3 volts). Determine "worst case" voltage at far end of each NAC, by subtracting its calculated V-drop from the expected battery voltage. The result must be no less than the minimum listed operating voltage for the alarm notification appliances used. All these calculations must be placed on a dedicated sheet of as-built drawings, for future reference by fire alarm service technicians.
 - iv. Provide copies of battery and voltage drop calculations at final inspection.
- c. Maintenance Data: The contractor shall submit maintenance data and parts lists for each type of fire alarm equipment installed, including furnished specialties and accessories. Include this data, product data, and shop drawings in maintenance manual.
- d. Maintenance Contract: The contractor shall submit a quote for a maintenance contract to provide all maintenance, test, and repair described below and/or in accordance with

NFPA-72, "Guide for Testing Protection Signaling Systems". Include also a quote for unscheduled maintenance/repair, including hourly rates for technicians trained on this equipment, and response travel costs. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of two (2) years after expiration of the guaranty. Maintenance and testing shall be on a semiannual basis or as required whichever is the most restrictive. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventive maintenance. The schedule shall include:

- 1) Inspection and testing of the fire alarm system in accordance with the requirements of NFPA 72 Chapter 14

e. Certifications:

- 1) Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses, and telephone numbers in the certification.
- 2) Installer's training certificate as defined under Quality Assurance.

B. PRODUCT

1. FIRE ALARM CONTROL PANEL (FACP)

a. FACP - General: The FACP shall meet the following general requirements (unless otherwise required by the owner for certain systems):

- 1) The system is to be the addressable type, with a 24vdc nominal operating voltage.
- 2) The system is to have multiple access levels so owner's authorized personnel can disable individual alarm inputs or normal system responses (outputs) for alarms, without changing the system's executive programming or affecting operation of the rest of the system. The process on how to do this must be included in the training required to be given to the owner's designated personnel, and must also be part of the written documentation provided by the fire alarm equipment supplier.
- 3) Signal Line Circuits: (SLC) also called addressable loop - Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded onto an NFPA Style 6 (Class A) Signaling Line Circuit (SLC) with no "T" taps.
- 4) Initiation Device Circuits: Initiation Device Circuits (IDC) shall be wired Class A (NFPA 72 Style D).
- 5) Notification Appliance Circuits: Notification appliance circuits shall be wired Class B (NFPA 72 Style Y).
- 6) Digitized electronic signals shall employ check digits or multiple polling. In general, a single ground or open on any system signaling line circuit, initiating

device circuit, or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

- 7) Loss of Power: Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
 - 8) The FACP must have an Alarm Silence switch and be equipped with the Subsequent Alarm (alarm resound) feature. Any remote annunciators or graphic displays located away from the alarm area must also include an audible signal with alarm resound feature.
 - 9) FACP - Minimum Requirements: The FACP shall contain a microprocessor based Central Processing Unit (CPU). The CPU and its associated equipment shall be protected so it cannot be affected by voltage surges or line transients consistent with UL standard 864. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent detectors, addressable modules, local and remote operator terminals, printers, annunciators, and other system-controlled devices. The main FACP shall perform the following functions:
 - i. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 - ii. Supervise all initiating, signaling, and notification circuits throughout the facility by way of connection to monitor and control modules, or end of line resistor.
 - iii. Visually and audibly annunciate any trouble, supervisory or alarm condition on operator's terminals, panel display, and annunciators.
- b. System Response to an Alarm Condition: When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
- 1) The system alarm LED shall flash.
 - 2) A local piezo-electric signal in the control panel shall sound.
 - 3) An 80-character minimum LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
 - 4) On systems equipped with a printer, printing and history storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.
 - 5) All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated. Exact programming shall be provided by the Contractor to meet the Owner's requirements.

- 6) Detect activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed.
 - 7) Activate all fire alarm Notification Appliances in the building, sounding and flashing in synchronization continuously until the initiating device and control unit have been reset to normal condition.
 - 8) Activate digital alarm communicator.
 - 9) Deactivate door hold control relay such that all smoke doors are allowed to close.
 - 10) Deactivate control relays so that HVAC units shut down. Exception is for hazardous exhaust systems and smoke control.
 - 11) Activate elevator recall sequence if smoke is detected in any elevator lobby, shaft, or in the elevator equipment room.
 - 12) Activate control relay(s) to release all magnetically locked egress doors.
- c. System Response to a Trouble Condition:
- 1) Systems AC power trouble signal shall not be sent unless maintained for 1 to 3 hours (or more) Provide additional relays as required for this purpose.
 - 2) Provide immediate transmission of all other supervising signals.
 - 3) Provide adjustable time delay for all other trouble signals prior to transmission.
- d. System Capacity and General Operation: The system shall have the following capacities and general operation modes:
- 1) The FACP shall provide or be capable of expansion to 198 intelligent/addressable devices per Signaling Line Circuits (SLC) and 1980 initiating points, minimum, per system. The number of SLCs provided shall be as indicated on the Drawings. Total points shall be as indicated on the drawings or otherwise specified with minimum 20% spare capacity.
 - 2) The FACP shall include a full featured operator interface control and annunciation panel that shall include a backlit, 80 minimum character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.
 - 3) All programming or editing of the existing program in the system shall be achieved with a personal computer on site. A copy of the database shall be left in the Document Box per NFPA 72.
 - 4) Notification Appliance Circuits with 20% spare capacity.
- e. The FACP shall be able to provide the following features:
- 1) Upload/Download to PC Computer
 - 2) Charger Rate Control

- 3) Drift Compensation
 - 4) Automatic Day/Night Sensitivity Adjust
 - 5) Device Blink Control
 - 6) Pre-alarm Control Panel Indication
 - 7) Trouble Reminder
 - 8) NFPA 72 Smoke Detector Sensitivity Test
 - 9) System Status Reports
 - 10) Periodic Detector Test
 - 11) Alarm Verification, by device, with tally
 - 12) Non-Alarm Module Reporting
 - 13) Block Acknowledge
 - 14) Smoke Detector Maintenance Alert
 - 15) Control-By-Time
- f. The control panel shall be capable of printing historical data and device parameters and shall include all equipment necessary to produce printouts, including an external printer and shall be U.L. listed as meeting the NFPA 72 sensitivity testing and maintenance requirements without the need for manually removing and testing each smoke detector. The control panel shall provide a display and a printed list of these sensitivity measurements as a permanent record of the required sensitivity testing. The system shall also annunciate a trouble condition when any smoke detector approaches 80% of its alarm threshold due to gradual contamination, with an annunciation of the location of the smoke detector requiring service. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
- g. The system shall perform time-based control functions including automatic changes of specified smoke detector sensitivity settings.
- h. Central Processing Unit: The Central Processing Unit (CPU) shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the CPU.
- 1) The CPU shall contain and execute all control-by-event (including ANDing, ORing, NOTing, CROSSZONEing) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure. The CPU shall also provide a real-time clock for time annotation of all system displays. The Time-of-Day and date shall not be lost if system primary and secondary power supplies fail.

- 2) The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- i. Operators Control: Provide an operator's interface which allows the following minimum functions. In addition, the operator's interface shall support any other functions required for system control and/or operation:
 - 1) Acknowledge (ACK/STEP) Switch
 - 2) Signal Silence Switch
 - 3) System Reset Switch
 - 4) System Test Switch
 - 5) Lamp Test Switch
 - 6) Programmable, supervised switches for fire safety function bypasses. i.e. NAC Bypass, Elevator Capture Bypass, HVAC Shutdown Defeat, Smoke Control Bypass, etc. Switch operation shall be password protected.
 - j. Display: The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
 - 1) The system display shall provide an 80 minimum -character back-lit alphanumeric Liquid Crystal Display (LCD).
 - 2) The Display shall also provide four Light-Emitting-Diodes (LEDs), that will indicate the status of the following system parameters: AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
 - 3) The system display shall provide a touch key-pad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
 - k. Signaling Line Circuit (SLC) Interface Board: The FACP shall contain SLC interface boards as required to communicate with the SLC. Each SLC board shall monitor and control a minimum of 198 intelligent addressable devices. This includes 99 analog detectors (Ionization, Photoelectric, or Thermal) and 99 monitor or control modules.
 - 1) Each SLC interface board shall contain its own microprocessor and shall be capable of operating in a local mode (any SLC input activates all or specific SLC outputs) in the event of a failure in the main CPU of the control panel. The SLC interface board shall not require any jumper cuts or address switch settings to initialize SLC Loop operations. SLC interface boards shall provide power and communicate with all intelligent addressable detectors and modules connected to its SLC Loop on a single pair of wires. This SLC Loop shall be capable of operation as NFPA 72 Class A (Style 6) or Class X (Style 7).

2) Each SLC interface board shall receive analog information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that specific detector. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

- l. Printer: Provide a printer to provide hard-copy printout of all changes in status of the system. The printer shall timestamp such printouts with the current time-of-day and date. The printer shall be standard carriage with 80-characters per line and shall use standard pin-feed paper. Thermal printers are not acceptable. The printer shall operate from a 120 VAC, 60 Hz power source. Provide table and stand for printer if it is to remain constantly connected to the fire alarm panel.
- m. Remote Transmissions: The FACP shall be interfaced to a Digital Alarm Communications Transmitter (DACT).
- n. Power Supply: The FACP power supplies shall operate on 120 VAC, 60 Hz and shall have a continuous rating adequate to power all equipment and functions in full alarm continuously. All modules and drivers must be able to withstand prolonged short circuits in the field wiring, either line-to-line or line-to-ground, without damage. Further, the power supply shall be expandable for additional notification appliance power in 3.0 Ampere increments.
- o. The power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge.
- p. Batteries: Shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have enough capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure. NAC circuits shall not exceed 75% of maximum current load allowed. (For batteries serving emergency voice communications the duration of alarm reserve shall be 15 minutes in lieu of 5 minutes)
- q. Enclosures: The FACP shall be housed in a 3rd party listed cabinet suitable for surface or semi-flush mounting. Cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be hinged on either the right or left side (field selectable).

2. ALARM APPLIANCES

- a. Programmable Electronic Sounders: Sounders located outdoors shall be listed for use in wet locations. Electric sounders shall operate with synchronized audible output and have the following specifications:
 - 1) Voltage: Programmable electronic sounders shall operate on 24 VDC nominal.

- 2) Programming: Electronic Sounders shall provide the ANSI S3.41 three-pulse temporal pattern audible evacuation signal, described in NFPA 72, with an output sound level of at least 90 dBA measured at 10 feet from the device. Output sound level shall be 110 dB maximum. Electronic Sounders shall be field programmable without the use of special tools.
- b. Strobe Lights shall be located as shown on the Drawings. Strobe lights indicated for use exterior to the building shall be mounted at the indicated elevation and listed for use in wet locations. Strobe lights shall operate with synchronized flash output and have the following specifications:
 - 1) Voltage: Strobe lights shall operate on 24 VDC nominal.
 - 2) Maximum pulse duration: 2/10ths of one second.
 - 3) Strobe intensity and flash rate: Must meet minimum requirements of UL 1971. Provide strobe lights with minimum intensity Candela (Cd) rating of 15 Cd, or greater if such is indicated adjacent to the device symbol on the Drawings. The Fire Alarm Contractor shall verify all candela settings prior to conducting the voltage drop testing required later in this document. Contractor shall also verify the design candela settings are adequate for the space being covered. Care must be taken to assure the devices are mounted in the exact locations shown on the approved shop drawing documents. Notify the designer of any deficiencies.
 - c. Horns: Where provided, shall provide average ambient sound level of 15 dBA as listed in the NEPA 72.
 - d. Horns and sounder bases in bedrooms or other sleeping rooms shall operate at 520-Hz with frequency tolerance permitted in NFPA 72.
 - e. Audible/Visual Combination Devices shall comply with all applicable requirements for both Programmable Electronic Sounders and Strobe Lights.
 - f. Bells shall be 10" diameter vibrating type located as shown on the Drawings; bells located outdoors shall be listed for use in wet locations. Bells shall have the following specifications: Voltage: Bells shall operate on 24 VDC nominal.
3. INITIATING DEVICES
- a. Addressable Devices - General: All initiating devices shall be individually addressable. Addressable devices shall comply with the following requirements:
 - 1) All addressable spot type and duct smoke detectors shall be the analog type and the alarm system shall automatically compensate for detector sensitivity changes due to ambient conditions and dust build-up within detectors. This feature must be armed, and sensitivities set prior to acceptance of the system.
 - 2) Address Setting: Addressable devices shall provide an address-setting means.
 - 3) Connections: Addressable devices shall be connected to a Signaling Line Circuit (SLC) with minimum two (2) wires.

- 4) Operational Indications: Addressable smoke and heat detectors shall provide dual LEDs. LEDs shall flash under normal conditions, indicating that the device is operational and in regular communication with the control panel. The flashing mode operation of the detector LEDs shall be optional through the system field program.
 - 5) Intelligent Initiation Devices: All smoke detectors shall be the "intelligent" in that smoke detector sensitivity shall be set through the FACP and shall be adjustable in the field through the field programming of the system. Sensitivity shall be capable of being automatically adjusted by the FACP on a time-of-day basis. Using software in the FACP, detectors shall be capable of automatically compensating for dust accumulation and other slow environmental changes that may affect performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
 - 6) Spot-type detectors must be the plug-in type, with a separate base (not a mounting ring), to facilitate their replacement and maintenance. The base shall have integral terminal strips for circuit connections, rather than wire pigtails.
 - 7) Device mounting Base: Unless otherwise specified all detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
 - 8) Sounder Base: Provide bases with a built-in (local) sounder rated at 85 dBA minimum, measured at 10ft. Configure sounder bases such that sounders are activated under conditions as described in the Matrix. Provide low frequency sounder bases in sleeping areas.
 - 9) Test Means: The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel when in the "test" condition. Actual or synthetic smoke must be used during the 100% testing to assure smoke entry into the sensing chamber.
 - 10) Device Identification: Detectors shall store an internal identifying type code that the control panel shall use to identify the type of device.
- b. Photoelectric Smoke Detectors: Photoelectric smoke detectors shall use the photoelectric (light- scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
 - c. Ionization Smoke Detector: Ionization smoke detectors shall use the dual-chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion.
 - d. Thermal Detectors: Thermal Detectors shall be intelligent addressable devices rated at 135°F (58°C) and shall have a rate-of-rise element rated at 15° F. (9.4°C) per minute. It shall connect via minimum two wires to the Fire Alarm Control Panel Signaling Line Circuit. Up to 99 intelligent heat detectors may connect to one SLC loop. Thermal detectors shall use an electronic sensor to measure thermal conditions caused by a fire

and shall, on command from the control panel, send data to the panel representing the analog level of such thermal measurements.

- 1) Non-Rate of Rise Detectors: Provide thermal detectors with non-rate of rise thermal elements. Non-rate of rise detectors is indicated by NRR adjacent to the thermal detector symbol. Where used in elevator machine rooms or hoist ways, select temperature rating nominal 10 degrees F less than the adjacent fire sprinkler.
 - 2) Specialized Element Temperature Ratings: Provide thermal detectors with specialized element temperature ratings. Specialized element temperatures are indicated by a temperature rating adjacent to the thermal detector symbol, e.g. 195°F.
- e. Multi-sensor Detectors: Detectors employ two or more of the above detection types with integrated operating principals, mounted in a single housing. The outputs of the analog sensors shall be transformed into digital signals that are combined and processed by special algorithms. The computations shall be designed to discriminate between normal ambient changes in a building and those changes associated with a fire. //Provide photoelectric smoke detection and rate of rise thermal detection. //Provide photoelectric smoke detection, ionization smoke detection and rate of rise thermal detection. //
- f. Duct Smoke Detector: In-Duct Smoke Detector Housings shall accommodate a velocity rated photoelectric detector. The device, independent of the type used, shall provide continuous analog monitoring and alarm verification from the panel. When enough smoke is sensed, a supervisory or alarm signal shall be initiated at the FACP. Coordinate with owner for response appropriate for the location.
- g. Addressable Pull Stations - General: Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key. All pull stations shall be dual action, have a positive, visual indication of operation and utilize a key type reset. The Glass-break rods are not allowed. Mount pull station with operating mechanism between 42-inches and 48-inches above finished floor.

4. MISCELLANEOUS SYSTEM ITEMS

- a. Addressable Dry Contact Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised zone (either Style D or Style B) of non-addressable Alarm Initiating Devices (any Normally Open [N.O.] dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings.
- 1) Indication of Operation: An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
 - 2) Supervision: Unless specifically noted otherwise on the drawings provide one monitor module for each sprinkler switch.

- b. Two Wire Detector Monitor Module: Addressable Monitor Modules shall be provided to connect one supervised IDC zone, Class B (Style D or B operation) of non-addressable 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device) to one of the Fire Alarm Control Panel Signaling Line Circuit Loops. Monitor modules shall be installed as required by the system configuration. All required monitor modules may not be shown on the Drawings. Indication of Operation: Unless otherwise indicated on the Drawings. An LED shall be provided that shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.
- c. Addressable Control Module: Addressable Control Modules shall be provided to supervise and control the operation of one conventional Notification Appliance Circuit (NAC) of compatible, 24 VDC powered, polarized Audio/Visual (A/V) Notification Appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay. The control module shall provide address-setting means. An LED shall be provided that shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel. If the voltage being controlled is 120 VAC or greater, an isolating 24 VDC relay shall be used.
 - 1) Configuration: The control module NAC circuit may be wired for (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form C) relay. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires. Designer shall confirm the relay contacts are rated for the attached load.
 - 2) Power Source: Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, 3rd party listed remote power supply. A/V power sources and connections are not shown on the Drawings.
- d. Isolator Module: Isolator Modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The Isolator Module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC Loop to 20 addressable devices. Modules must be readily accessible (not above ceiling) and clearly labeled.
 - 1) Operation: Isolator Modules shall operate such that if a wire-to-wire short occurs, the Isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the Isolator Module shall automatically reconnect the isolated section. The Isolator Module's operations shall be totally automatic.
 - 2) The Isolator Modules shall provide a single LED that shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated
- e. Water Flow Switch: Flow switches shall be integral, mechanical, non-coded, non-accumulative retard type. Flow switches shall have an alarm transmission delay time that is conveniently adjustable from 0 to 60 seconds. Initial settings shall be 30-45

seconds. Flow switches shall be located a minimum of one (1) foot from a fitting that changes the direction of the flow and a minimum of three (3) feet from a valve as required per NFPA 13. Installation: Water Flow Switches shall be connected by the Division 16 (Electrical) Contractor but furnished and installed by the Division 23 (Mechanical) Contractor.

- f. Sprinkler and Standpipe Valve Supervisory Switch: Supervisory switch mechanisms shall be contained in a weatherproof housings that shall provide a 3/4 inch tapped conduit entrance and shall incorporate the necessary facilities for attachment to the valves. Switch housing shall be finished in red baked enamel. Mounting: Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
- g. Serially Connected Remote Annunciator: Annunciator shall communicate with the fire alarm control panel via an EIA-485 communications loop (four-wire) and shall individually annunciate all zones in the system. System zones shall be as indicated on the Drawings. Up to 10 annunciators may be connected to the EIA-485 communications loop.
 - 1) Annunciator Indicators: The annunciator shall provide a red Alarm LED per zone, and a yellow Trouble LED per zone. The annunciator shall also have an "ON-LINE" LED, local piezo sounder, local acknowledge/lamp test switch, and custom zone/function identification labels. Annunciator switches may be used for System control such as, Global Acknowledge, Global Signal Silence, and Global System Reset. All annunciator switches and indicators shall be software programmable.
 - 2) LCD Alphanumeric Display Annunciator: The Alphanumeric Display Annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of eighty (80) characters for alarm annunciation in clear English text. The LCD Annunciator shall display all alarms and trouble conditions in the system.
 - 3) System Capacity: The system shall allow a minimum of four LCD annunciators. In addition to annunciation functions, each LCD annunciator shall be capable of the following software programmed system functions: Acknowledge, Signal Silence and Reset.
 - 4) Connections: The annunciator shall connect to a two-wire EIA-485 interface. The two-wire connection shall be capable operation at distances of 6,000 feet. Provide interface to fiber optic cable systems and/or repeater units where such are indicated on the Drawings.
- h. Remote Annunciator Indicator Lights (RAIL): RAILS shall be provided with a key type switch for testing of the annunciated device. In addition. RAILS shall have the following features: Voltage: RAILS shall operate on 24 VDC nominal.
- i. Door Hold-Open Magnets: Door hold open magnets shall be suitable for mounting in a single gang electrical device box. Door hold open magnets shall be furnished with keepers, door chains, and other accessories as required to properly hold open doors as indicated on the Drawings. Holding force of the magnet shall be appropriate for the door to be held open. Door hold open magnets shall operate in a fail safe manner, i.e.,

the door shall release in event of a failure of voltage to the device. Power Source: Door hold open magnets shall be configured to operate from a nominal 24 VDC system as supplied by the FACP or other power supply listed for the purpose. All hold open magnet supply sources, whether a part of the FACP or whether derived from a separate power supply, shall be supervised. Door hold open magnet circuits which use step-down transformers, 120 VAC, or local relays are not permitted. Door shall close after 60 seconds of the power loss.

- j. Battery Power Supply (BPS) &/or Supplementary Notification Appliance Circuit (SNAC): These types of panels shall be completely maintenance free, shall not require liquids, fluid level checks or refilling, and shall not be capable of producing spills and/or leaks. Batteries shall be sealed gel-cell type with expected life of 10 years. Battery voltage shall be as required by the FACP and related equipment. Battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure. Battery cabinet shall be twice the size of the batteries it will contain. NAC circuits shall not exceed 75% of maximum current load allowed.
- k. Surge Protection: The following protection against voltage transients and surges must be provided by the fire alarm equipment supplier, and installed by the electrical contractor:

- 1) On AC Input: A feed-through (not shunt-type) branch circuit transient suppressor such as Leviton 51020-WM-DIN, or Ditek DTK-120SRD 20 Amp or equivalent UL 1449 - Latest Edition Listed device.
- 2) On DC Circuits Extending Outside Building: At a point near entry to the building provide "pi"- type filter on each leg, consisting of a primary arrester, series impedance, and a fast-acting secondary arrester that clamps at 30v-40v.

Some acceptable models: Simplex 2081-9027, Simplex 2081-9028, Transtector TSP8601, Ditek DTK 2MHL P24BWB series, Citel America B280-24V, and Northern Technologies DLP-42.

Submit data on others to the engineer for approval. UL 497B listing is normally a prerequisite for their consideration. Devices using only MOV active elements are not acceptable.

5. Wiring

- a. Addressable loop (signaling line) circuits shall be wired with type FPL/FPLR/FPLP fire alarm cable, AWG 18 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 FACP. Acceptable cables include Atlas 228-18-1-1STP, BSCC S1802s19 (same as EEC 7806LC), West Penn D975, D991 (AWG 16), D995 (AWG 14), or equal wire having capacitance of 30pf/ft. maximum between conductors. Belden 5320FJ acceptable if only FPL rating needed. The cable jacket color shall be red, with red (+) and black (-) conductor insulation.
 - 1) Unshielded cable, otherwise equal to the above, is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable.

- 2) In underground conduit, use Type TC or PLTC cable (PE insulated) to avoid problems from moisture.

C. EXECUTION

1. FIRE ALARM SYSTEM:

- a. The fire alarm system shall be new and furnished with a warranty (parts & labor) of at least one year from the date of beneficial occupancy or final inspection by SCO and Owner. Equipment, initiating devices, and alarm appliances shall be arranged, and the annunciator zones shall be configured as described by the engineer's written specifications.
- b. All equipment supplied must be specifically listed for its intended use and shall be installed in accordance with the manufacture's recommendations. The contractor shall consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation. Contractor shall refer to the Riser/Connection diagram for all specific system installation/termination/wiring data.
- c. Do not locate addressable modules in unconditioned spaces.
- d. All system components shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load. Adhesives are not permitted to mount fire alarm system components to building surfaces or structure. See Symbol sheet.
- e. When programming the system, activate the automatic drift compensation feature for all spot type smoke detectors. Systems with alarm verification are not to have this feature activated without written direction from the owner's representative or the AHJ. Alarm verification must not be used with multi-sensor/multi-criteria detectors under any circumstances, as inadequate system response may result.
- f. Set spot-type smoke detector sensitivities to normal/medium, unless directed otherwise by the design engineer/owner's rep.
- g. Print a complete System Status and Programming Report after the above steps have been done. This must include the program settings for each alarm initiating device and the current sensitivity of each analog addressable smoke detector. This documentation shall be provided at the SCO inspection.

2. FIRE ALARM CONTROL EQUIPMENT INSTALLATION

- a. The technician who makes final connections and programs the FACP is the "installer" even though most field connections to system devices and appliances are normally made by electrical contractor personnel. The responsibility for assuring a proper installation overall rests with this individual fire alarm system technician. In addition to doing the final hookups and activating the system, this individual is expected to check the field connections to assure all work is properly done. The absence of system "trouble" signals is not an adequate measure of the field wiring, which could have "T" taps, the wrong type of wire, improper terminations, ground (drain wire) issues, etc.

- b. Notification Appliance Circuit booster power supplies must be individually monitored by the FACP and protected by a smoke detector per NFPA 72. They shall not be located above a ceiling, or in non- conditioned space. A 24vdc power circuit serving addressable control relays must also be monitored for integrity. All fire alarm power supplies shall have 120-volts surge suppressors.
- c. Basic operating instructions shall be framed and permanently mounted at the FACP. (If the owner concurs, they may instead be affixed to the inside of the FACP's door.) In addition, the NFPA 72 "Record of Completion" must either be kept at the FACP, or its location shall be permanently indicated there by an engraved label. All System documentation shall be provided and housed in a Documentation Cabinet at the control panel or other approved location. (Per 2013 NFPA 72: 7.7.2)
- d. Provide an engraved label on outside of the FACP door identifying its 120-vac power source, as follows: Panelboard location, panelboard identification, and branch circuit number. On inside of FACP door, indicate panelboard location.
- e. Alarm notification appliances (audible and visible) are to comply with NFPA 72, the North Carolina Building Code, and ANSI 117 criteria for intensity and placement. The standard audible evacuation signal is the ANSI S3.41 three-pulse temporal pattern. All strobe lights installed in a single space must be synchronized. Devices can be mounted on the ceiling. Wall mounted devices shall be mounted with the entire lens between 80" minimum and 96" maximum off finished floor. See the NFPA 72 for additional alarm notification appliance requirements for special situations.

3. SURGE PROTECTION

- a. For each AC power circuit that interfaces with fire alarm equipment, install an AC suppressor in a listed enclosure near the electrical panelboard, and trim excess lead lengths. Wind small coil in the branch circuit conductor just downstream of the suppressor connection. Coil to be 5 to 10 turns, about 1" diameter, and securely tie-wrapped. This series impedance will improve the effectiveness of the suppressor in clipping fast rise time voltage transients.
- b. On DC Circuits Extending Outside Building: Install the surge arrestor in a labeled enclosure near the point of entry to or exit from each building.

4. SIGNALING LINE CIRCUITS

- a. One loop per floor for signaling-line circuits. Outgoing and return loops must be in separate raceways per 2013 NFPA 72. (12.3.7) Provide isolation modules (or isolator bases) along each SLC (addressable loop). 20 devices max between ISO's.

5. AC POWER

- a. Systems are to be provided with a separate and independent source of emergency power. Switching to emergency power during alarm shall not cause signal drop-out. Batteries must meet the appropriate NFPA capacity requirements, with a 25% safety factor. This requirement is in effect even if generator power is supplied to the Fire Alarm Control Panel.

- b. The branch circuit breaker(s) supplying the system must be physically protected by a breaker handle lock-on device and each must be identified with a 1/4" permanent red dot applied to handle or exposed body area.
- c. Provide an engraved label at each fire alarm system control unit, system sub-panel or data gathering panel, supplementary notification appliance (SNAC) panel, digital alarm communicator, etc. identifying the panel location, panel name, and breaker number for the 120VAC circuit. Example:

Electrical Rm 120 Panel EP1

Circuit 22

- d. The fire alarm system shall monitor 120-VAC power to shunt trip breakers used in conjunction with fire suppression systems. Examples include a shunt trip used for cooking appliance power shut-off when the kitchen hood fire suppression system shoots, or primary elevator power shut-down upon heat detector activation in sprinkled hoist ways or machine rooms. Use an addressable monitor module to accomplish this supervisory function. Provide a breaker handle lock-on device on circuits used for shunt trip power.

6. CONDUIT AND WIRING

- a. The exterior of all junction boxes containing fire alarm conductors shall be painted red; box interiors shall not be painted. Box covers for junction boxes containing fire alarm conductors shall be painted red on both sides.
- b. Box covers shall be labeled to indicate the circuit(s) or function of the conductors contained therein. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- c. All fire alarm system wiring shall be in metal conduit or surface metal raceway. All fire alarm system raceway, couplers, and connectors must meet the performance and installation requirements of Electrical Specification Section "RACEWAYS".
 - 1) Cable size and the requirement to maintain a Class "A" or Class "X" loop on all Signaling Line Circuits cause conduit fill to exceed specified maximums for the 1/2" size; therefore, 3/4" raceway should be used.
 - 2) PVC conduit is permitted to be used underground, in concrete, and in locations approved by the AHJ.
- d. All conduits that penetrate outside walls from air-conditioned space must have internal sealing (duct- seal), to prevent condensation from infiltrating humid air.
- e. All wiring shall be color coded. All the circuits in the system shall be wired with AWG 14, minimum, stranded copper, THHN/THWN conductor, installed in metallic conduits. Color Coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:
 - 1) Initiating Circuits, General -----Red (+)/White (-)
 - 2) Initiating Circuits, Smoke Only -----Violet (+)/Gray (-)

- 3) Signal Line Circuit cable -----Red jacket with Red (+)/Black (-)
 - 4) Alarm Indicating Appliance Circuits ----- Blue (+)/Black (-)
 - 5) AHU Shutdown Circuits -----Yellow (+)/Brown (-)
 - 6) Door Control Circuits ----- Orange
 - 7) Elevator Capture Circuits ----- Brown
- f. To minimize wiring fault impact, isolation modules shall be provided in all the locations listed below. If ceiling height ≤ 10 feet, isolator base type initiating devices are permitted to be used to satisfy any or all the following
- 2) In or immediately adjacent to the FACP, at each end of the addressable loop. These two isolators must be in the same room and within 15 feet of the FACP.
 - 3) After each 20 initiating devices and control points on the addressable loop, or a lesser number where recommended by the manufacturer. (Check instructions.)
 - 4) 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 FACP).
 - 5) Near the point any addressable circuit extends outside the building, except for those attached to the building exterior walls and well sheltered by walkways.
 - 6) For loops covering more than one floor, install isolator at terminal cabinet on each floor (with additional isolator[s] on any floor with over 20 addresses).
 - 7) Each isolation module must be clearly labeled, readily accessible for convenient inspection (not above a lay-in ceiling), and shown on as-built drawings
- g. Detection or alarm circuits must not be included in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated by a minimum of .25 inches per NEC, from other circuits, and the enclosure must have an appropriate warning label, to alert service personnel to the potential hazard. See NEC 760.136.
- h. Class A or X Circuits Required: Systems with one or more addressable sub-panels that (1) have an integral addressable loop controller, or (2) monitor multiple non-addressable initiation zones, shall comply with the NFPA 72 requirements for Class "A" or "X" circuits for their networking cables.
- i. There shall be no splices in the system other than at device terminal blocks, or on terminal blocks in cabinets. "Wire nuts" and crimp splices will not be permitted. Permanent wire markers shall be used to identify all connections at the FACP and other control equipment, at power supplies, and in terminal cabinets. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
- j. In multistory buildings, all circuits leaving the riser on each floor shall feed through a labeled terminal block in a hinged enclosure accessible from the floor. If building layout requires the terminal cabinet to be above a drop ceiling, its location must be

clearly and permanently identified with a placard readable from floor. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.

- k. All wiring shall be checked for grounds, opens, and shorts, prior to termination at panels and installation of detector heads. The minimum resistance to ground or between any two conductors shall be ten (10) megohms, as verified with an insulation tester. Provide advanced notice to the Engineer of record of these tests.
 - l. The system shall be electrically supervised for open or (+/-) ground fault conditions in SLC, alarm circuits, and control circuits. Removal of any detection device, alarm appliance, plug-in relay, system module, or standby battery connection shall also result in a trouble signal. Fire alarm signal shall override trouble signals, but any pre-alarm trouble signal shall reappear when the panel is reset.
6. ADDRESSABLE PULL STATIONS
- a. Addressable pull stations shall, on command from the Control Panel, send data to the panel representing the state of the manual switch. They shall use a key operated test-reset lock and shall be designed so that after actual emergency operation, they cannot be restored to normal use except using a key. All pull stations shall be dual action, have a positive, visual indication of operation and utilize a key type reset. Glass-break rods are not allowed. Mount pull station with operating mechanism between 42-inches and 48-inches above finished floor.
7. NOTIFICATION DEVICES
- a. Both audible and visible alarm signals shall be provided. Visible signals for fire alarm must be the strobe (flash discharge) type, with white or clear lens, and shall comply with current ADA requirements for intensity and placement.
 - b. Alarm notification appliance (NAC) circuits shall be NFPA 72 Class "A" or Class "B". The load connected to each circuit must not exceed 80% of rated module output. The NAC voltage drop during alarm must not exceed 14% of the voltage measured across the batteries at that time. To achieve this, the design must consider wire size, length of circuit, device load, inherent voltage loss within the FACP power supply, etc. The contractor shall use power outage testing to verify that the NAC circuit was designed and installed properly.
 - c. The location of all end of line devices shall be labeled on the device, with NAC panel number and NAC circuit number, and recorded on the "As-built" drawings. EOL shall not be located more than 12-feet above finished floor.
8. DETECTORS
- a. The FACP and all other control equipment locations, including any transponders, sub-panels, and booster power supplies, must be protected by a spot type smoke detector located within 15 feet of the equipment (measured horizontally).
 - b. When installed in a room, detectors shall be oriented, so their alarm light is visible from the nearest door to the corridor, unless Remote Alarm Indicator Light (RAIL) equipped.

- c. Spot-type smoke detectors shall secure the head to the base thru the built-in locking device. For detector mounted within 12 feet of the floor, activate this lock after the system has been inspected and given final acceptance.
- d. 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 must be replaced by the contractor at no additional cost to the Owner. Covers supplied with smoke detector heads do not provide protection against heavy construction dust, spray painting, etc., and must not be used for that purpose. They are suitable only during final, minor cleanup or touchup operations.
- e. A detector installed where accidental damage or deliberate abuse is expected shall be provided with a guard that is listed for use with it and is acceptable to the AHJ.
- f. Identification of individual detectors is required. Assign each a unique number as follows, in sequence starting at the FACP: (Addressable Loop # -- Device #) Show on the as-built plans, and permanently mount on each detector's base so that it's readable standing on the floor below without having to remove the smoke detector. Exception: For detectors with housings (i.e., air duct, projected beam, air sampling, flame), apply the identification to a suitable location on exterior of their housing. Device labels may not be affixed to the device. Identification labels must be printed labels with black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- g. Addressable Interface Modules (control and monitor modules)
 - 1) Addressable interface modules (used to monitor all contact type initiating devices) must be in a conditioned space, unless they are tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed location.
 - 2) One module may serve as many as 6 heat detectors, in a single space.

9. DUCT MOUNTED SMOKE DETECTORS

- a. All air duct/plenum detectors must have a Remote Alarm Indicator Lamp with test switch (RAILS) installed in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. Duct smoke detectors are permitted to be installed only inside an air duct. It is not appropriate to mount them in front of a return air opening. Duct detectors shall also be installed in a manner that provides suitable, convenient access for required periodic cleaning and calibration. The numbers of detectors per duct shall be per NFPA 72 requirements based on the size of the air duct, air duct configuration, air speed, and duct manufacture's installation requirements.
- b. 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.
- c. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with far end support for stability.

- i. The preferred method for providing support is to extend the intake tube through the far side of the duct, seal around the tube where it penetrates the duct wall and plug the end with a rubber stopper. This facilitates visual inspection and intake tube cleaning.
- d. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The contractor shall mark the direction of air flow on the duct at each duct detector location.
- e. Avoid the use of duct detectors on outside air intakes, as this can lead to nuisance alarms and troubles from moisture and dust.
- f. A fire alarm panel output for a duct detector signal shall be as required by NC Building Codes and NFPA 72.

10. AIR HANDLER UNIT (AHU) SHUTDOWN

- a. A supervised "AHU Shutdown Defeat" switch must be provided in/adjacent to the FACP or as a key- operated function in the Remote Annunciator (if provided). If the FAA option is utilized, provide an informative engraved label at the FACP about this function. The switch must cause a system "trouble" indication when it's placed in the off-normal ("Shutdown Defeated") position. This is to provide the owner with a convenient means to temporarily resume HVAC operation in the event an unwanted alarm will not clear, prior to arrival of the fire alarm service technician, or for testing purposes.
- b. If the building has smoke control system fans (pressurization or exhaust), or smoke purge fans, provide Hand-Auto-Off switches at an approved location. They must be clearly labeled, and FACP - monitored or provided with status indicator lights. This is often provided by the controls contractor, rather than the fire alarm contractor, and does not need to be part of the fire alarm system. Responsibility should be clearly indicated in the project specification. For three-position toggle switches we recommend this intuitive arrangement: Hand (Manual Run) to be "up" and have an amber LED; Auto to be center position with a green LED; Off to be down and have a red LED.
- c. All shutdown relays must be directly controlled and monitored by the fire alarm system. The Building Automation System (BAS) shall not be used for life safety functions unless the BAS is supervised by the Fire Alarm System for off normal conditions. Relays should be wired fail safe. (BAS systems typically are not battery backed and typically do not supervise themselves or their wiring, for faults or communication loss between processors or CPU's.)
- d. Buildings with smoke control or smoke removal systems shall have the Fire Fighter's Smoke Control Panel monitored by the Fire Alarm System, for all trouble conditions.

11. REMOTE ALARM TRANSMISSION REQUIREMENTS

- a. Each system with automatic fire detection, or which monitors a sprinkler system, shall be equipped with a 4-channel (minimum) Digital Alarm Communicator Transmitter (DACT) for transmission of fire alarm, supervisory, and trouble signals to a Central Station, Remote Supervising Station, or Proprietary Supervising Station. DACT shall be dual transmission link type in accordance with NFPA 72. Transmission shall be

cellular and VOIP. Provide back-up power for signal transmission equipment as required in NFPA 72.'

- b. The following signals shall be reported:
 - 1) Fire Alarm
 - 2) Fire Alarm System AC Power Trouble (only if 120vac interrupted for 1 to 8 hours)
- c. The precedence of DACT / signals transmitted to the Supervising Station shall be as follows:
 - 1) Fire Alarm
 - 2) Supervisory Signal
 - 3) Trouble Signal*
- d. Do not confuse fire suppression system "supervisory" signals and fire alarm system "trouble" signals. These are completely different types of signals, annunciated and transmitted as separate and distinct events.
- e. The Contractor must provide a type of DACT that is compatible with the owner's alarm receiving equipment, or the Supervising Station selected by the owner, as applicable. He must also program the PROM, connect each DACT to the data line provided to him, and verify proper signal receipt by the Supervising Station. The transmission means shall comply with NFPA 72.

12. FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION

- a. Supervision required: The connection between individual addressable modules and their contact type initiating device(s) must be supervised.
- b. Graphic Chart must be mounted behind Plexiglas and secured to surface. Mounting shall be such that charts cannot be removed without the proper tools.
- c. Floor Plans with Device Numbers: A copy of the floor plans shall be provided in the Documentation Cabinet at the control panel. A separate sheet shall be provided for each floor. Plans shall be reduced in size from engineering plans in order to fit on 11 x 14 sheets. All device addresses shall be clearly labeled on plans. Indicate locations of all cabinets, modules and end of line device.
- d. Loop 1 shall be assigned to the lowest level devices and loop number shall increase with floor number. Device numbering starts in the same location on each floor and increase accordingly as circuit location increases.

13. SYSTEM DOCUMENTATION, TRAINING, AND MAINTENANCE

- a. Maintenance: The manufacturer, or authorized distributor, must maintain software version (VER) records on the system installed. The system software shall be upgraded free of any charge if a new VER is released during the warranty period. For new VER

to correct operating problems, free upgrade shall apply during the entire life of the system.

- b. System Report In addition to the Shop Drawing submittal described elsewhere, the fire alarm system contractor shall provide the engineer two bound copies of the following technical information, for transmittal to the owner:
 - 1) As-Built wiring diagram showing all loop numbers and device addresses, plus terminal numbers where they connect to control equipment.
 - 2) As-built wiring and conduit layout diagrams, including wire color code and/or label numbers, and showing all interconnections in the system.
 - 3) Electronic circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
 - 4) Manufacturer detailed maintenance requirement.
 - 5) Technical literature on all control equipment, isolation modules, power supplies, batteries, detectors, manual stations, alarm/supervisory signal initiating devices, alarm notification appliances, relays, remote alarm transmission means, etc.
 - 6) The as-built "calculations" sheet.
- c. Electronic archive: Complete configuration data (site-specific programming) for the system must be stored on electronic media and archived by the fire alarm system manufacturer or authorized distributor. A USB drive or CD copy of this data shall be submitted to the engineer for transmission to the owner on the day the system is commissioned. A copy of this site-specific data base shall also be placed in the Documentation Cabinet.
- d. The contractor shall provide the owner with one copy of the following:
 - 1) All software required for the installed fire alarm system.
 - 2) Complete documentation for all software for both the installed fire alarm system and for any interface PC software necessary for system functions as described above.
 - 3) Framed floor plans mounted at the FACP: Plans shall show all system devices with the unique device identification numbers indicated adjacent to each device. The identification numbers shall match those represented in the as-built drawings and those reported at the FACP and the LCD annunciator. As-built room numbers shall match the signage in the building.
 - 4) Interconnection cable where such is required to connect the fire alarm system to a PC; (if Owner does not have the needed PC to check the system).
- e. The manufacturer's authorized representative must instruct the owner's designated employees in operation of the system, and in all required periodic maintenance. A minimum of 8 hours on-site time will be allocated for this purpose and, for those facilities operating on a 24-hour basis (prisons, hospitals, etc.) one additional hour of

instruction will be individually provided for the 2nd and 3rd shift. Two copies of a written, bound summary will be provided, for future reference.

- 1) Some facilities maintain their own systems and require more in-depth training. Check to verify needs and requirements.
- 2) Scheduling of training must be arranged to meet the Owner's schedule. Additional training shall be available at a cost to be mutually agreed upon by the Owner and the Contractor.
- 3) Training shall be in the Owner's provided classroom.
- 4) The training may not be waived, deleted or reduced in the number of hours required.
- 5) Training shall cover as minimum the following topics:
 - i. Preventive maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
 - ii. Overall system concepts, capabilities, and functions. Training shall be in depth, so that the owner shall be able to take any device out of service and return any device to service without need of Manufacturer's approval or assistance.
 - iii. Explanation of all control functions, including training to program and operate the system software.
 - iv. Methods and means of troubleshooting and replacement of all field wiring devices.
 - v. Methods and procedures for troubleshooting the main fire alarm control panel, including field peripheral devices as to programming, bussing systems, internal panel and unit wiring, circuitry and interconnections.
 - vi. Manuals, drawings, and technical documentation. Actual system software used for training shall be provided in digital form and shall be left with the Owner at the completion of training for the Owner's use in the future. *Training Quote: Provide a quote for one of the owner's Employees to receive factory certification level training on the system being installed. Quote is to include travel, room and food allowance.

14. SPARE PARTS:

- a. The following spare parts shall be provided with the system. For multi-building projects, calculate quantities separately for each building that contains a dedicated fire alarm control panel. If FACP also serves auxiliary buildings (e.g., storage, boiler/chiller), calculate as if one building. Increase decimal quantities to the next higher whole number.

Fuses (If Used)	2 of each size in system
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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

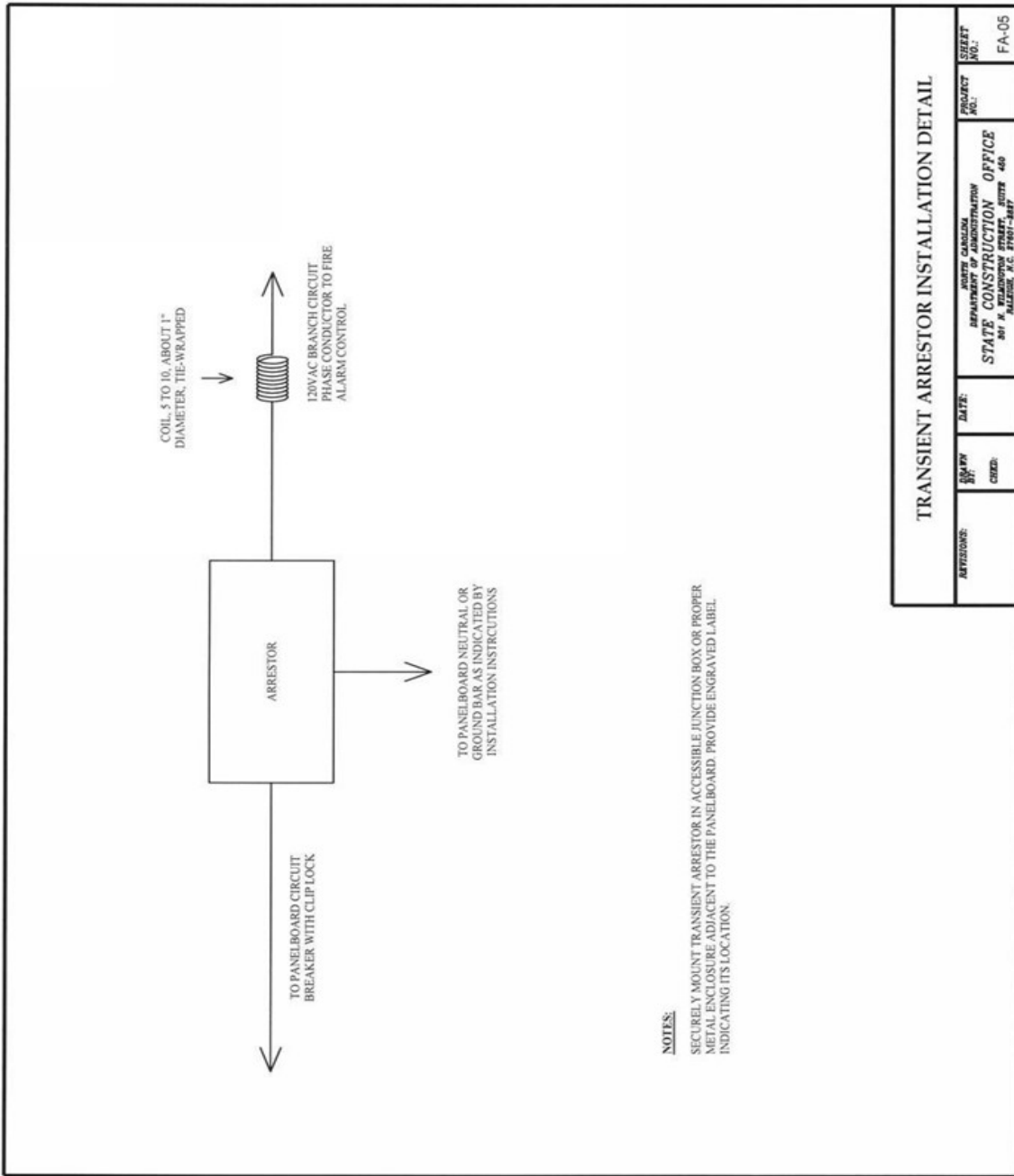
No spares are required for projected beam, air sampling, or duct smoke detectors

15. SYSTEM TESTING & CERTIFICATION

- a. Upon completion of the installation the Contractor and the Manufacturer's authorized installer and designer together shall conduct a 100% performance test of every alarm initiating device for proper response. The system shall operate for 48 hours prior to start of test. The Contractor shall be present for the full 100% test. The person responsible for programming the system must be present.
- b. The A/E and owner must be given 7 days' notice of the tests. All Audio-Visual Device Testing shall be scheduled with the owner.
- c. 100% Test: The manufacturer or authorized distributor (by definition, "installer") must 100% test all site-specific software functions for the system and then provide a detailed report or check list showing the system's operational matrix. This documentation must be part of the "System Status and Programming Report". Provide an alarm and trouble history printout at the SCO inspection, documenting this 100% test.
 - 1) Upon completion of the installation and its programming, the installer's technician shall test every alarm initiating device for proper response and indication, and all alarm notification appliances for effectiveness. Also, in coordination with the other building system contractors, all other system functions shall be verified, including (where applicable) elevator capture and the control of HVAC systems, door locks, pressurization fans, fire or smoke doors/dampers/shutters, motor control centers, etc. The engineer shall witness these tests.
 - 2) If AHU shutdown occurs for any alarm, then the matrix would indicate the specific control relay(s) for that function being commanded to operate for alarm from any initiating device. If a rolling steel fire door is to drop only upon water flow alarm from its sprinkler zone, or upon any two spot smoke detectors in adjacent spaces being simultaneously in alarm, the matrix would show the door's control relay activating upon alarm from the applicable water flow switch(es), or from any two smoke detectors in the selected spaces (AND gate)

- 3) The digital communicator shall be on-line and tested for proper communication to the receiving station.
 - 4) All supervised circuits must also be tested to verify proper supervision. (Control circuits and remote annunciation lines are among those required to be supervised.)
 - 5) All testing described above shall be repeated if subsequent software or wiring modifications are determined necessary to meet the requirements of the contract documents. Such re-testing shall be included as part of the base bid and provided at no additional cost to the Owner.
 - 6) The contractor and engineer shall verify the voltage drop of each NAC circuit by testing and recording the voltage at the origin and at the EOL for each NAC circuit, under battery power only. Prior to conducting these tests, the contractor shall verify the candela settings of all strobes. Provide documentation of these tests at the SCO final inspection.
- d. Test Documentation: The installer must fill out and submit the following documentation to the owner, through the engineer, prior to the AHJ's system acceptance inspection:
- 1) Written verification that this 100% system test was done with copy of print out generated during test.
 - 2) The NFPA 72, "Record of Completion" Form. Use this form (no substitutes) to detail the system installation and to certify that: (a.) It was done per Code, and (b.) The Code required 100% test was performed. The fire alarm installer (manufacturer or authorized distributor's technician) must sign this form. If a representative of the AHJ, owner, or engineer witnesses the tests, in whole or in part, they must also sign the form to signify that fact only (annotating the form as needed to clarify their limited role).
 - 3) For buildings with a smoke control or smoke purge system, an HVAC balance report, in the smoke control / smoke purge mode.
 - 4) The System Status and Programming Report described in NFPA 72. This must be generated on the day of the system acceptance inspection and shall include the measured sensitivity of each smoke detector.
 - 5) The purpose of doing Item (4) on the day of the inspection is to assure detector sensitivity has not been affected by construction dust. Prudent contractors will have taken measures to prevent detector contamination during construction and will also have had the system do a detector sensitivity test and printout prior to the day of the inspection, to make certain all devices are properly programmed and operating within their limits.
- e. After completion of the 100% system test and submission of documentation as described above the installer is to request the engineer to set up an inspection. The system must operate for at least two days prior to this inspection. The responding Fire Department shall be notified of this, for pre- fire planning purposes. On local government projects, local fire authorities may also want to participate in system

acceptance inspections. However, for State-owned property they have no inspection



END OF SECTION 283100

SECTION 285000 - BI-DIRECTIONAL ANTENNA SYSTEM (BDA)

A. GENERAL

1. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies as required by the local AHJ (Authority Having Jurisdiction). System users shall receive and transmit radio signals from their portable radio units within the building. This shall be accomplished utilizing the following components:
 - a. Bi Directional Amplifiers (Signal Boosters)
 - b. Coaxial Cable
 - c. Antennas
 - d. Cable taps
 - e. Connectors
 - f. Power dividers
 - g. Other components and interconnecting circuitry as required
2. The system shall comply with the requirements of UL2524 In-building 2-Way Emergency Radio Communication Enhancement Systems, NFPA 72 2013 Edition, NFPA 1221 2016 Edition and 2018 NC Fire Code, as referenced.
3. The entire system shall meet the requirements of the Fire Department, the Building Department and all other agencies and authorities having jurisdiction (AHJ).
4. The work in this section shall include the responsibility for all permit requirements with the AHJ. Where filings require engineer's signature, documents shall be submitted for his review and signature. This responsibility shall include furnishing of required quantities of floor plans, descriptive notes and/or specifications, wiring diagrams, shop drawings and amendment forms.
5. Early completion of the in-building emergency radio communication enhancement system will be required as to permit a Certificate of Occupancy to be obtained in a timely manner.
6. Any permits necessary for the installation of the work shall be obtained prior to the commencement of the work. All permit costs and inspection fees shall be included
7. The in-building emergency radio communication enhancement system shall use a UL2524, NFPA 72, NFPA 1221 and IFC 2018 compliant signal booster.
8. Submittals
 - a. Prior to performing any installation work. The fire alarm contractor shall submit complete Shop Drawings to the engineer for review. Upon approval by engineer, the

contractor shall submit to AHJ for approval. The shop drawing shall clearly demonstrate compliance with the engineer's plans and specifications. Any non-compliant features must be fully described.

- b. Shop drawing submittal shall include a copy of the valid FCC-issued general radio operators license who design the system.
9. Authority Having Jurisdiction (AHJ):
- a. The AHJ for Code compliance is the town of Winterville Fire Marshal Office. No building permit is required for construction or renovation of facilities that are funded by the State of North Carolina and located on State-owned land. Contractor shall field coordinate site Inspections with AHJ.

B. PRODUCTS

1. The system specified shall be based upon UL2524, NFPA72, NFPA 1221 compliant signal boosters
2. The signal booster shall be a Class B Public Safety type as designated by the FCC or as required by the AHJ.
3. The secondary power supplies, battery chargers and system monitoring shall be fully compliant with NFPA 72, NFPA 1221 and 2018 NC Fire Code. The signal booster shall have both the primary and the secondary power supplies within a waterproof, type-4 approved enclosure.
4. All signal boosters and other active system components must have FCC certification prior to installation. The equipment FCC ID must be shown on the product datasheets and technical submittals. The ID must also be displayed on the product as required by the FCC.
5. The signal booster shall be pre-set by the equipment manufacturer for the frequencies specified by the AHJ. Field tuning of RF filters and duplexers is not allowed.
6. UHF and VHF signal boosters shall be band selective type with a maximum 3dB channel bandwidth of 200KHz ($F_c \pm 100\text{KHz}$) per band. Non-selective wide-band signal boosters shall not be accepted, unless required to cover multiple channels within the same band.
7. Signal Boosters shall have oscillation suppression circuitry to protect the public safety radio system in case of system malfunction or other causes. The oscillation suppression circuit shall not disable the system operation. Systems that automatically disable the signal booster upon oscillation detection shall not be allowed.
8. Signal Boosters shall have uplink noise suppression function to eliminate uplink noise while in standby (i.e. no radio transmission from within a building). Systems that produce any measurable level of uplink noise while in standby shall not be allowed.
9. Signal Booster gain shall be rated at minimum of 80dB and the gain shall be adjustable in a minimum of 30dB range. System gain shall be set and documented at the time of the final system test.

10. Maximum Propagation delay of the signal booster system shall be 14 μ s (microseconds) or as specified by AHJ.
11. The signal booster system shall include built-in automatic supervision of malfunctions of the signal booster and battery system as per NFPA 1221 NFPA 72 and 2018 NC Fire Code. Non-OEM equipment add-ons and modifications to comply with this specification shall not be allowed.
12. A dedicated supervised monitoring panel shall be provided within the emergency command center next to the fire alarm panel / annunciator or other location as designated by AHJ to annunciate the status of all signal booster locations. The monitoring panel shall provide visual and labeled indication of the following for each signal booster:
 - a. Normal AC power
 - b. Signal booster trouble
 - c. Antenna Failure
 - d. Loss of normal AC power
 - e. Failure of battery charger
 - f. Low battery capacity
13. External filters, duplexers, power supplies or other non-OEM additions or modifications of the original equipment shall not be allowed. All duplexers shall be built-in and FCC certified with the signal booster as an complete and fully integrated FCC-certified and UL-Listed unit.
14. All signal booster components shall be contained in a type-4 approved waterproof enclosure. All enclosures shall be painted red with external labeling as required by the AHJ.

C. EXECUTION

1. Design requirements
 - a. Contractor shall provide system design as stated in 2018 NC Fire Code section 510.4.
 - b. In-building emergency radio communication enhancement systems for emergency responders are an integral component of the life safety equipment of a building or structure. The primary function is to provide reliable emergency responder communications at the required signal strength within the specified areas.
 - c. Critical Areas such as emergency command center, fire pump room, exit stairs, exit passageways, elevator lobbies, standpipe cabinets, sprinkler sectional valve locations and similar critical areas shall be provided with 100% floor area radio coverage.

- d. General building areas shall be provided with 95% radio coverage, or as specified by AHJ.
- e. The In-building emergency radio communication enhancement systems must provide the following signal strengths:
 - 1) Downlink - Minimum signal strength of -95 dBm throughout the coverage area.
 - 2) Uplink - Minimum signal strength of -95 dBm received at the AHJ Radio System.
 - 3) OR As otherwise required by the AHJ
- f. The system shall be complete with all components and wiring required for compliance with all applicable codes and regulations, and for its operations described hereinafter.
- g. An approved manufacturer or a qualified and approved vendor shall supply, test and determine locations of components which are required for proper operation as well as to supply, install, test and certify the performance of the complete system. Vendor qualifications must be acceptable to the AHJ.
- h. Design shall include software-simulated radio propagation modeling with heat maps showing predicted signal coverage levels within the building. The design shall be done by the software certified personnel.
- i. All tests shall be conducted, documented, and signed by a person in possession of an FCC General Radio Telephone Operators License. All testing personnel shall be certified and authorized by the signal booster manufacturer in the installation and operation of their equipment. Personnel qualifications must be acceptable to the AHJ.
- j. The system design shall be based on the Public Safety Signal Boosters UL2524, NFPA 72, NFPA 1221, 2018 NC Fire Code and FCC certified to establish standards of quality for materials and performance. The naming of a specific manufacturer or a catalog number does not waiver any requirement or performance of individual components described in the specifications.
- k. Assembly and installation of all components of the Emergency Responder Radio Communication Enhancement System shall comply with all applicable sections of the National Electrical Code.
- l. Survivability from attack by fire shall meet requirements of NFPA 72, NFPA 1221, 2018 NC Fire Code or as required by the local jurisdiction.
- m. The system must comply with all applicable sections of the FCC rules. Signal booster shall have FCC certification prior to installation.

- n. Antenna isolation shall be maintained between the donor antenna and all inside antennas (Distributed Antenna System - DAS) to a minimum of 20dB under all operating conditions
2. Approval prior to installation. Amplification system capable of operating on frequencies licensed to any public safety agency by the FCC shall not be installed without prior coordination and approval of the fire code official.
3. Installation of all components of the Emergency Responder Communication Enhancement System shall comply with all applicable sections of the National Electrical Code NFPA-70, NFPA-72, NFPA 1221, 2018 NC Fire Code or as required by the local AHJ.
4. At least 2 independent and reliable power supplies shall be provided as specified in NFPA 72, NFPA 1221 and 2018 NC Fire Code.
5. The primary power source shall be supplied from a dedicated twenty (20) ampere branch circuit and comply with NFPA-70 National Electrical Code, NFPA 72 and NFPA 1221 2016 edition.

The signal booster shall be equipped with a secondary source of power. The secondary source of power shall be a battery system with a dedicated battery charger powered by a separate, dedicated twenty (20) ampere branch circuit. The secondary power supply shall power on automatically when the primary power source is lost. The secondary source of power shall be capable of operating the emergency responder radio coverage enhancement system for a period of at least 24 hours. The battery system shall automatically charge in the presence of external power input. Battery charger and all other electronic components must be fully enclosed in a waterproof Type-4 approved enclosure. Batteries shall be enclosed in a separate, vented Type-3R approved enclosure. External UPS (Uninterruptable Power Supplies) are not acceptable.

6. RF Coaxial Cable shall be a listed, CMP plenum. Non-plenum cable can be used when installed in a metallic raceway. The cable classification shall be clearly marked on the outer surface of the cable regular intervals.
7. Acceptance and Test Procedures
 - a. The acceptance test procedure shall be as stated in 2018 NC Fire Code section 510.5.3 or as directed by the AHJ.
 - b. Acceptance testing for an in-building radio system is required upon completion of installation.
 - c. The coverage testing shall be done in accordance with NFPA 72, NFPA 1221, 2018 NC Fire Code and as required by the local AHJ
 - d. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License.

- e. All test records along with system diagrams, design, equipment specifications, user manuals, RF link budget calculations, battery backup calculation and other design data shall be submitted upon completion of the project, and as required by the AHJ.

END OF SECTION 285000

SECTION 285500 - RF SURVEY FOR EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM

A. GENERAL

1. SUMMARY

- a. The purpose of this specification is to establish the requirements and standards for initial survey for public safety radio signal strength per NFPA and 2018 NC Fire Code.
- b. Survey should be performed after the building is substantially completed, and prior to start of installation of electrical wiring.
- c. Conduct a survey using a RF Spectrum Analyzer, a calibrated, system-compatible radio or another suitable instrument with traceable certificate of calibration to analyze the RF signal strength of Emergency Responder Radio Signal into the building and determine if amplification of the signal is required. Both inbound and outbound signal strength shall be determined, measured, calculated and documented as required by code.

2. SURVEY CRITERIA IF REQUIRED

- a. The required Public Safety Radio Signal Level inside the Owner's facility must be determined per code, ordinance or AHJ
- b. Survey shall be performed by an FCC licensed technician holding a current GROL license. Honeywell Fire have distributors that meet these requirements.

3. REGULATIONS

- a. Codes, regulations and standards referenced in the Section are:
 - 1) NFPA 1 – The National Fire Code (including Annex O from 2009)
 - 2) NFPA 70, 2017 Edition – The National Electrical Code
 - 3) 2018 NC Fire Code, Section 510- Emergency Responder Radio Coverage
 - 4) NFPA 101, Life Safety Code, the Ohio Building Code, and Local Code and Building Authority requirements.
 - 5) NFPA 72, 2013 Edition - National Fire Alarm Code
 - 6) FCC 47 CFR Private Land Mobile Radio, Part 90.219 Services-Use of Signal Boosters
 - 7) 2018 NC Building and Fire Codes
 - 8) ADA "Americans with Disabilities Act"

- 9) FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields"
- 10) FCC Rules Part 22, Part 90 and Part 101
- 11) NFPA 1221 2016 Edition
- 12) UL 2524

4. DEFINITIONS

a. Definitions:

- 1) Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage.
- 2) Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services, or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.
- 3) FCC: Federal Communications Commission
- 4) OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- 5) Public Safety/First Responder: Public Safety or First Responder agencies that are charged with the responsibility of responding to emergency situations. These include, but are not limited to law enforcement departments, fire departments, and emergency medical companies.
- 6) RSSI: Received signal strength indicator RSSI is a measurement of the power present in a received radio signal.
- 7) BER: Bit Error Rate is the number of bit errors per unit time
- 8) GROL- FCC General Radio Operators License
- 9) ERRCES- Emergency Responder Radio Coverage Enhancement System
- 10) DAS-Distributed Antenna System

B. EXECUTION

1. TESTING PROCEDURES

- a. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the. -95dBm nominal signal at 100%.

- b. Spectrum Analyzer or Calibrated Handheld Radio shall be used as basis for signal measurements or other method as approved by AHJ.
- c. Testing should be based on a minimum of 20 grid locations per floor OR maximum of 1600 SQ ft. areas if the floor exceeds 32,000 Sq. Ft. Also, testing should include all critical areas per NFPA. See A.2 of this specification and NFPA 72 2013 or NFPA 1221 2016. OR per any method determined by the AHJ, local code or ordinance.
- d. A minimum signal strength of -95 dBm shall be provided throughout the coverage area for both uplink and downlink by the Local Fire Department.
 - 1) RSSI measurement only

2. SURVEY SUBMITTALS

- a. Submit testing data for each level of the building.
 - 1) An RF measurement drawing of each floor of the building which indicates relative RF field strength for each frequency band of interest must be submitted to the AHJ.
 - 2) The drawing should indicate clearly the areas that have passed or failed based on the above parameters.

END OF SECTION 285500

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The Specification Sections applying to the Site Work for the PITT COMMUNITY COLLEGE NEW WELDING BUILDING in Winterville, North Carolina are as follows:

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11-13-23

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

RELATED DOCUMENTS:

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

Contractor shall refer to Section 012200 – Unit Prices for administrative and procedural requirements for the handling of unsuitable soils as described by this Section.

DESCRIPTION OF WORK:

Extent of earthwork is indicated on drawings.

Preparation of subgrade for curb and gutter and pavements is included as part of this work.

Preparation of building pad is included as part of this work.

Definition: "Excavation" consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

QUALITY ASSURANCE:

Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction and NCDOT specs.

Testing and Inspection Service: Owner will engage soil testing and inspection service for quality control testing during earthwork operations.

SUBMITTALS:

Test Reports-Excavating: Submit following reports directly to Architect/Engineer from the testing services, with copy to Contractor:

Test reports on soil and embedment.

Field density test reports.

One optimum moisture-maximum density curve for each type of soil encountered.

JOB CONDITIONS:

Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Engineer, then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Engineer, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Use of Explosives: The use of explosives is not permitted.

Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

PART 2 - PRODUCTS

SOIL MATERIALS:

Definitions:

Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification Groups GW, GP, GM, GC, SM, SW and SP, or a combination of these groups having less than 20% by weight of fines, a liquid limit less than 20, and plastic limit less than 6; free of rubble, organics, clay, debris, waste, frozen materials, vegetation, and other deleterious matter.

Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups ML, MH, CL, CH, OL, SC, OH and PT or a combination of these groups.

Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

Aggregate for Aggregate Base Course: Aggregate meeting the requirements of Section 520 of "Standard Specifications for Roads and Structures" as issued by NCDOT.

Drainage (Porous) Fill: A 4-inch layer of washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

Select Backfill: Job excavated or borrow material consisting of coarse sands, fine sands, with not more than 15% by weight passing the No. 200 sieve. This does not include clays, silts, organic soils or any materials not acceptable as fill material. Select backfill must receive prior approval from the Engineer before use.

Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.

PART 3 - EXECUTION

EXCAVATION:

Excavation:

Excavation for the parking lot, building, and area behind curb shall conform to the lines, grades, cross sections, and dimensions indicated on the drawings and shall include the excavation of all unsuitable materials from the subgrade. Subgrade shall conform to proposed line, grade and cross-section. The subgrade in a fill section is based on the grade after stripping, clearing, grubbing and removing vegetation and organics. This operation shall include any reshaping and wetting or drying required to obtain proper compaction. Once the subgrade is established all soft or otherwise unsuitable material shall be removed and replaced with suitable material at the measurement and direction of the Geotechnical Engineer.

Excavation is Unclassified, and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

Subgrade Inspections:

Notify Architect when excavations have reached required subgrade.

If Architect's representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

The exposed subgrade soils in the extended building footprint shall be densified in place using a medium weight vibratory roller, except within 30 feet of the existing building where static rolling shall be utilized. The vibratory rolling shall extend a distance of 10 feet outside the perimeter of the building. The roller should make at least 6 passes across the site, with the second set of 3 passes perpendicular to the first set of 3 passes. If water is brought to the surface by the vibratory rolling, the operation shall be discontinued until the water subsides. Vibratory rolling should be completed during dry weather. After the vibratory rolling, pore pressures should be allowed to dissipate for a minimum of 16 hours. After the waiting period, proof rolling operations under the building shall be performed.

Proof-roll subgrade below the building slabs with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h). Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes). Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

Building Foundation Excavation:

Notify Architect when excavations have reached required depth.

If Architect's representative determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

The Architects representative shall use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing shall be performed to a depth of 3 to 5 feet below the bottom of footing excavations. Excessively soft, loose or wet bearing soils shall be overexcavated to a

depth recommended by the architects' representative. Footings can bear directly on these soils at the lower level or the excavated soils could be replaced with compacted soil fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric (Mirafi 140 N or equivalent).

Pavement Excavation: When excavation has reached required subgrade elevations, provide a proof rolling of the prepared pavement subgrade with a heavy roller or loaded dump truck (+25 tons) in the presence of the Engineer's Representative. The proof rolling shall be covered by the wheels of the proof roller operating at a speed between 2-1/2 and 3-1/2 miles per hour.

Any areas that rut or pump excessively shall be scarified by the contractor and allowed to dry. If the areas continue to rut or pump they shall be undercut and backfilled with select material as directed by the Engineer.

After undercut and backfill operations are complete, a final proofrolling of the undercut areas will be performed in the presence of the Engineer's Representative.

Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.

Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

Dispose of excess soil material and waste materials as herein specified.

Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degree F (1 degree C).

COMPACTION:

General: Control soil compaction during construction providing minimum percentage of density specified for each area classification as indicated below.

Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density at optimum moisture content as determined by ASTM D 698.

Structures, Building Slabs, Steps and Pavements: Compact top 12" of subgrade at 98% maximum density. Each layer of backfill or fill material below top 12" shall be compacted to 95% maximum density.

Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum density.

Walkways: Compact top 6" of subgrade and each layer of backfill or fill material at 95% maximum density.

Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

BACKFILL AND FILL:

General: Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.

In excavations, use satisfactory excavated or borrow material.

Under grassed areas, use satisfactory excavated or borrow material.

Under walks and pavements, use subbase material, or satisfactory excavated or borrow material, or combination of both.

Backfill excavations as promptly as work permits, but not until completion of the following:

Inspection, testing, approval, and recording locations of underground utilities.

Removal of trash and debris.

Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

GRADING:

General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

Grade areas as shown on the Drawings to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.05' above or below required subgrade elevation.

Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2" above or below required subgrade elevation.

Patches in driveways and roadways shall be graded to depth required to match existing pavement or to provide minimum pavement specified.

Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

PAVEMENT SUBBASE COURSE:

General: Subbase course consists of placing subbase material, in layers of specified thickness, over subgrade surface to support a pavement base course.

See other Division-2 sections for paving specifications.

Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12" width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

When a compacted subbase course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

FIELD QUALITY CONTROL:

Quality Control Testing During Construction: After stripping, proofrolling shall be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation in cut areas with a loaded, tandem-axle dump truck or similar rubber-tired construction equipment. The proofrolling vehicle should be lightly loaded for the building footprint and loaded for the parking lot. The proofrolling should be performed during a period of dry weather to avoid degrading an otherwise

suitable subgrade. Subgrade soils that exhibit excessive rutting or deflection during proofrolling should be overexcavated as directed by the Engineer and replaced with properly compacted fill. Proofrolling shall be observed by the testing services firm.

At the time of the foundation excavation, the testing services firm will use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing shall be performed to a depth of 3 to 5 feet below the bottom of footing excavation. Excessively soft, loose or wet bearing soils should be overexcavated to a depth recommended by the Engineer and backfilled with suitable fill.

MAINTENANCE:

Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

DISPOSAL OF EXCESS AND WASTE MATERIALS:

Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of it off Owner's property.

END OF SECTION 312000

SECTION 312200 - TRENCHING, BACKFILLING AND COMPACTION

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

Contractor shall refer to Section 012200 – Unit Prices for administrative and procedural requirements for the handling of unsuitable soils as described by this Section.

DESCRIPTION OF WORK:

This section covers excavation and trenching work and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; and other appurtenant work.

RELATED WORK SPECIFIED ELSEWHERE:

Storm Sewer System - Section 334100

Gravity Sanitary Sewer System – Section 333100

Water Pipe and Pipe Fittings – Section 332110

QUALITY ASSURANCE:

Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction and the Occupational Safety and Health Administration, OSHA. Provide a competent person on site at all times excavations are open. “Competent Person” means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

The Owner shall employ a testing laboratory to perform testing and inspection service for quality control.

SUBMITTALS:

Test Reports-Excavating: Submit following reports directly to Engineer from the testing services, with copy to Contractor:

Test reports on soil and embedment.

Field density test reports.

One optimum moisture-maximum density curve for each type of soil encountered.

JOB CONDITIONS:

Classification of Excavated Materials: No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.

Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after acceptable temporary utility services have been provided.

Provide minimum of 48-hour notice to Engineer, and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Use of Explosives: The use of explosives is not permitted.

Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

PART 2 - PRODUCTS

DEFINITIONS:

Satisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups GW, GP, GM, GC, SM, SW, and SP.

Unsatisfactory soil materials are defined as those complying with ASTM D 2487 soil classification groups ML, MH, CL, CH, SC, OL, OH and PT.

GENERAL MATERIALS:

Clean Sand: Washed or natural sand with less than 10 percent by weight passing the No. 200 sieve.

Filter Cloth: Spun synthetic fiber, 10 oz/sy, burst strength 500 psi, vertical water flow 265 gpm/sf, Trevira 1135, Mirafi or equal.

Granular Fill (Embedment and Stabilization Material): Granular fill or embedment material shall be crushed rock or gravel, shall be free from dust, clay, or trash, and shall be #57 stone as defined in ASTM C 33.

Aggregate Base Course Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand as specified in NC DOT Standard Specifications for Roads and Structures Section 520 Type A.

Fill Material (Backfill): All material deposited in trenches shall be free from rocks or stones larger than 2 inches, brush, stumps, logs, roots, debris, and organic or other objectionable materials, and shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content.

Select Backfill: Job excavation or borrow material consisting of coarse sands and fine sands with not more than 15% by weight passing the No. 200 sieve. This does not include clays, silts, organic soils or any materials not acceptable as fill material. Select backfill must receive prior approval from the ENGINEER before use.

Groundwater Barrier: Barrier material shall meet ASTM D2487 soil classification GC, SC, CL, or ML-CL and shall be compacted to 95 percent of maximum density. Material may be finely divided

suitable job excavated material, free from stones, organic matter and debris.

PIPE EMBEDMENT:

Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements shown on the drawings and to the following supplementary requirements. Embedment materials shall contain no cinders or other material which may cause pipe corrosion.

Class B Bedding shall be used for all ABS and PVC Truss pipelines and PVC sewer service weyes.

Class B bedding shall include granular embedment from 4" below the pipe to the springline, compacted select backfill embedment to the top of the pipe and handplaced select backfill embedment at least 12" above the pipe as shown on the attached drawing.

Class D Bedding shall be used for all PVC (SDR 35) gravity sewer pipe.

Class D Bedding shall include granular embedment from 4" below the pipe to the top of the pipe and compacted select backfill embedment at least 12" above the pipe.

Class E Bedding shall be used for all PVC pressure pipe.

Class E embedment shall include select backfill embedment from 4" below the pipe to at least 12" above the pipe.

Class F Bedding shall be used for all ductile iron and PVC waterlines, reinforced concrete pipe.

Class F embedment shall include compacted backfill material from the bottom of the pipe and bell holes to at least 12" above the pipe.

PART 3 - EXECUTION

GENERAL REQUIREMENTS:

Excavation shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Except where exterior surfaces are specified to be dampproofed, monolithic concrete manholes and

other concrete structures, or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches clearance is provided for outside plastering.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow or ice be placed in any backfill, fill or embankment.

DEWATERING:

Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for concrete structures or trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations 12 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

SHEETING AND SHORING:

Except where banks are cut back on a stable slope, excavation for structures and trenches shall be sheeted, braced, and shored as necessary to prevent caving or sliding.

Trench sheeting shall not be pulled before backfilling unless the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting, nor shall sheeting be pulled after backfilling. Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

STABILIZATION:

Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel. The stabilizing material shall be spread and compacted to a depth of not more than 4 inches; if the required depth exceeds 4 inches, the material shall be furnished and installed as specified for granular fills. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilizing subgrades shall not be above subgrade elevations indicated on the drawings.

EARTH FILLS AND EMBANKMENTS:

To the maximum extent available, excess suitable material obtained from structure and trench excavations shall be used for construction of fills and embankments. Additional material shall be provided as required or obtained from the borrow pits where indicated on the drawings. After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that surface materials of the subgrade will be compact and well bonded with the first layer of the fill or embankment.

Fills and embankments shall be constructed in horizontal layers not exceeding 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled prior to compaction. Each layer shall be thoroughly compacted to 95 percent of the maximum density at optimum moisture content as determined by ASTM D 698. If the material fails to meet the density specified, compaction methods shall be altered.

Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.

EXCAVATION FOR STRUCTURES:

Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

In excavation for footings and foundations, take care not to disturb bottom of excavation. Trim

bottoms to required lines and grades to leave solid base to receive other work.

ROADWAY EXCAVATION:

Excavation for the roadways shall conform to the lines, grades, cross sections, and dimensions indicated on the drawings and shall include the excavation of all unsuitable material from the subgrade. The top 18" of subgrade shall be compacted to 98% maximum density. Each layer of backfill or fill material below top 12" shall be compacted to 95% maximum density as determined by ASTM D 698. Subgrade shall conform to proposed line, grade and cross-section. This operation shall include any reshaping and wetting or drying required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

Limiting Trench Widths: Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths from the bottom of the trench to an elevation one foot above the top of installed pipe, and the minimum permissible sidewall clearances between the installed pipe and each trench wall shall be as follows:

<u>Nominal Pipe Size</u> (inches)	<u>Minimum Trench Width</u> (inches)	<u>Maximum Trench Width</u> (inches)
Less than 18	Pipe O.D. Plus 18	Pipe O.D. Plus 24
18 through 30	Pipe O.D. Plus 24	Pipe O.D. Plus 30
34 through 48	Pipe O.D. Plus 24	Pipe O.D. Plus 36

Stipulated minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot above the top of the pipe.

Unauthorized Trench Widths: Where, for any reason, the width of the lower portion of the trench, as excavated at any point, exceeds the maximum permitted in the foregoing tables, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and with the concurrence of the Engineer, shall be furnished and installed by and at the expense of the Contractor.

Mechanical Excavation: The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that

uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench, Undercutting the trench sidewall to obtain clearance will not be permitted.

Cutting Concrete and Asphalt Surface Construction: Cuts in concrete and asphalt pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 2 inches deep along each side of the trench and along the perimeter of cuts for structures.

Concrete and asphalt pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6 inches in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the centerline of the trench.

Pavement removed for connections to existing lines or structures shall not be of greater extent than necessary for the installation.

Where the trench parallels the length of concrete walks and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and replaced between existing joints or between saw cuts as specified for pavement.

Excavation Below Pipe Subgrade: Where required, pipe trenches shall be excavated below the underside of the pipe, to provide for the installation of granular embedment.

Artificial Foundations in Trenches: Whenever unsuitable or unstable soil conditions which cannot be corrected by dewatering are encountered, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable stabilization material. The use of stabilization material (stone) shall be approved by the Engineer's Representative prior to installation.

Bell Holes: Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

PIPE EMBEDMENT:

Placement and Compaction: Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of

pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material or trench bottom and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations. Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Hand placed embedment shall be compacted to the top of the pipe in all areas where compacted backfill is specified.

Whenever crushed rock is used as embedment for 36 inch and larger pipe, the portion above the bottom of the pipe shall be vibrated with a mechanical probe type vibrator during placement to ensure that all spaces beneath the pipe are filled.

Ground Water Barrier: Continuity of embedment material shall be interrupted by low permeability ground water barriers to impede passage of water through the embedment. Ground water barriers for sewer lines shall be compacted soil around each manhole. Barriers for all other pipelines shall be compacted soil the full depth of granular material, the full trench width, approximately 4 feet long, and spaced not more than 400 feet apart.

TRENCH BACKFILL:

Compact top 12" of subgrade at 98% maximum density. Each layer of backfill or fill material below top 12" shall be compacted to 95% maximum density, in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks or other surface construction or structures.

Where in street, road, or highway shoulders.

Where beneath fills or embankments.

In established lawn areas.

In other areas the backfill shall be compacted to 95 percent or equal to existing.

Where the trench for one pipe passes beneath the trench for another pipe, backfill for the lower trench shall be compacted to the level of the bottom of the upper trench.

Job excavation material may be used for compacted backfill when the job excavated material is finely divided and free from debris, organic material, cinders or other corrosive material, and stones larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used. Each layer of material shall have the best practicable moisture content for satisfactory compaction. The

material in each layer shall be wetted or dried as required and thoroughly mixed to ensure uniform moisture content and adequate compaction. Backfill materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Increased layer thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the Engineer that the specified compacted density will be obtained.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The top portion of backfill beneath established lawn areas shall be finished with not less than 4 inches of topsoil corresponding to, or better than, that underlying adjoining lawn areas.

STRUCTURE BACKFILL:

The quality and moisture content of materials for backfill around and outside of structures shall conform to the requirements for fill materials. Backfill materials shall be deposited in layers not to exceed 8 inches in uncompacted thickness and compacted to at least 98 percent of maximum density at optimum moisture content as determined by ASTM D 698. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

No backfill shall be deposited or compacted in water. Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, parking areas, walks, curbs, gutters, or other surface construction or structures. In addition, wherever a trench is to pass through structure backfill, the structure backfill shall be placed and compacted to an elevation not less than 12 inches above the top of pipe elevation before the trench is excavated. Compacted areas, in each case, shall be adequate to support the item to be constructed or placed thereon.

DRAINAGE MAINTENANCE:

Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other water courses by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

DISPOSAL OF EXCESS EXCAVATED MATERIALS:

Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of the work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.

For excavation in street rights-of-way, Contractor shall grade work area to within 0.1 foot \pm of proposed subgrade. For excavation in easements, excess excavation may be distributed within the easements, to a maximum depth of 6 inches above the original ground surface elevation at and across the trench and sloping uniformly each way.

All wasted material shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the Contractor and no separate payment will be made therefore.

SETTLEMENT:

The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or Owner.

TESTS:

As stipulated in the quality control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of the Contractor. Two initial gradation tests shall be made for each type of embedment, fill, or backfill material and one additional gradation test shall be made for each additional 500 tons of each material. Moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be paid for out of the testing allowance.

END OF SECTION 312200

SECTION 313116 - TERMITE CONTROL

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. Soil treatment with termiticide.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of termite control product.
 - 1. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For termite control products, from manufacturer.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located, and who employs workers trained and approved by manufacturer to install manufacturer's products.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 - 1. Warranty Period: Five years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. FMC Corporation, Agricultural Products Group; Dragnet FT, Talstar, Prevail.
 - d. Syngenta; Demon TC, Prelude, Probuild TC.
 - 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 313116

SECTION 321216 – ASPHALT PAVING

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including General and Special Conditions and Division-1 Specification sections apply to work of this section.

Related Work Specified Elsewhere:

Earth Moving: Section 312000

DESCRIPTION OF WORK:

The extent of work under this item includes the placement of aggregate base course and bituminous concrete pavement.

Bituminous concrete paving shall also mean bituminous paving, asphalt, or asphalt concrete as may be used in other sections of the specifications or drawings.

SUBMITTALS:

Material Certificates: Bituminous Concrete Paving:

Provide 2 copies of materials certificates signed by the material producer and the Contractor, and notarized, certifying that each material item complies with, or exceeds, specified requirements.

Job Mix Formula:

Provide 2 copies of the proposed job mix formula at least 15 days prior to beginning work. If this formula has not been previously approved by NCDOT for the type of pavement specified, Contractor shall, at his own expense take whatever measures are necessary in order to obtain said approval prior to beginning work or have a mix design prepared by an approved Testing Lab.

JOB CONDITIONS:

Weather Limitations: Construction operations shall be conducted in accordance with the weather limitations given in the applicable sections of "Standard Specifications for Roads and Structures" as issued by N. C. Department of Transportation. No asphalt concrete shall be placed when the

ambient temperature is less than 40 degrees F in the shade away from artificial heat.

Grade Control: Establish and maintain required lines and elevations as necessary to match existing grades and/or proposed grades on the drawings.

PART 2 - PRODUCTS

MATERIALS:

Aggregate for Aggregate Base Course: Aggregate meeting the requirements of Section 520-2 of "Standard Specifications for Roads and Structures" as issued by NCDOT.

Asphalt Concrete Plant Mix Pavements: Materials meeting the requirements of Section 610-2 of "Standard Specifications for Road and Structures" as issued by NCDOT.

Tack Coat: Materials meeting the requirements of Section 605-2 of "Standard Specifications for Road and Structures" as issued by NCDOT.

PART 3 - EXECUTION

GENERAL:

Install the aggregate base course, bituminous concrete base course, bituminous surface course, bituminous concrete binder course and tack coat in accordance with the applicable provisions of "Standards Specifications for Roads and Structures" as issued by the North Carolina Department of Transportation, except as otherwise noted herein.

SUBGRADE:

Shape surface of areas under base course to line, grade and cross-section shown on drawings, with finish surface not more than 1/2" above or below the required subgrade elevation.

Patches in driveways and roadways shall be graded to depth required to match existing pavement or to provide minimum pavement specified.

AGGREGATE BASE COURSE:

Place base course material on prepared subgrade in layers of uniform thickness. Grade the base course evenly to thickness indicated on drawings and compact to 100%. AASHTO T 180.

Maintain a uniform surface on the base course until the placement of the bituminous surface course is complete.

Provide a proof rolling of the compacted aggregate base course with a heavy roller or loaded dump truck (+25 tons) in the presence of the Engineer's Representative. The proof rolling shall be covered by the wheels of the proof roller operating at a speed between 2- 1/2 and 3-1/2 miles per hour.

Any areas that rut or pump excessively shall be allowed to dry or shall be undercut and backfilled with select backfill or coarse aggregate base course as directed by the Engineer.

After undercut and backfill operations are complete, a final proof rolling of the undercut areas will be performed in the presence of the Engineer's Representative.

TACK COAT:

Tack coat shall be applied to contact surfaces of previously constructed asphalt or portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. All application of tack coat shall be in conformance with Section 605 of the N.C. Highway Specifications for Roads and Structures dated January 1, 2002.

Tack coat shall be uniformly applied at a rate 0.02 to 0.05 gallons per square yard. No more tack coat material shall be applied than can be covered with base, binder, or surface course during the following day's operations. No base, binder or surface mixture shall be deposited thereon until the tack coat has sufficiently cured to properly receive paving.

All exposed surfaces, not intended to contact paving, shall be protected sufficiently to prevent tack coat from being tracked or splattered on said surfaces. After the tack coat has been applied, it shall be protected until it has cured for a sufficient length of time to prevent it from being picked up by traffic.

PLACING BITUMINOUS CONCRETE PAVEMENT:

Place bituminous concrete pavement in as continuous an operation as possible. The Contractor shall spread the materials to uniform density and strike a smooth finish true to cross-section and free from inequalities. Spread mixture at minimum temperature of 225 degrees F. Place each course in the required amounts, so that when compacted, they will conform to the indicated grade, cross section, and thickness.

Asphalt shall be put down in two courses.

Provide joints between old and new pavements and between successive days' work for continuous bond between adjoining work. Clean contact surfaces and apply tack coat.

Rolling: Begin rolling when bituminous concrete mixture will bear roller weight without excessive

displacement. Repair surface defects with hot bituminous concrete material as rolling progresses. Cut out and patch defective areas and roll to blend with adjacent satisfactory paving. Continue rolling until maximum density is attained and roller marks eliminated.

Protect paving from damage and vehicular traffic until bituminous concrete mixture has cooled and attained its maximum degree of hardness.

FIELD QUALITY CONTROL:

General: Test the in-place bituminous concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by the Engineer.

Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

Course Aggregate Base Course: 1/2", plus or minus

Bituminous Concrete Course: 1/4", plus or minus.

Surface Smoothness: Test finished surface of each bituminous concrete course for smoothness, using 10' straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable if exceeding the following tolerances for smoothness:

Wearing Course Surface: 1/4".

Check surfaced areas at intervals as directed by the Engineer.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

RELATED DOCUMENTS:

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

DESCRIPTION OF WORK:

Concrete work includes, but is not specifically limited to, concrete piers, pipe encasement, concrete curbs and gutters, concrete drives, walks and other concrete items required in the project.

RELATED ITEMS SPECIFIED ELSEWHERE:

Storm Sewer System: Section 334100

QUALITY ASSURANCE:

Codes and Standards: ACI 301 "Specifications for Structural Concrete for Buildings"; ACI 347 "Recommended Practice for Concrete Formwork", ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete"; comply with applicable provisions except as otherwise indicated.

Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Engineer.

Concrete Testing Service: Employ a testing laboratory acceptable to the Engineer to perform material evaluation tests and to design concrete mixes at Contractor's expense.

Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. Certificates of compliance must be signed by the materials produced and the Contractor.

PART 2 - PRODUCTS

CONCRETE MATERIALS:

Portland Cement: ASTM C150, Type 1, unless otherwise acceptable to the Engineer.

Aggregates: ASTM C33, except local aggregates of proven durability may be used when acceptable to the Engineer.

Water: Clean, potable.

Design strength: 3000 psi for sidewalks curb and gutter, drives, etc.; 3,000 PSI with 3/8" aggregate for masonry fill; 2500 psi for pipe blocking and encasement.

No admixtures containing calcium chloride may be used. Use Pozzolith by Master Builders, Plastiment or Plasticrete by Silka and Chemstrong A, R, or W by Castle Chemical Company or approved equal. Retarders and accelerators shall be used only as directed by the Engineer.

Air-Entraining Admixture: ASTM C260. Only use admixtures having neutralized vensol resins. Use MB-VR by Master Builders, SIK A AER by Sika Chemical Company, or CASTLE VR by Castle Chemical Company, or approved equal.

Use air-entraining admixture in all concrete, providing not less than 4% nor more than 6% entrained air.

Water-Reducing Admixture: ASTM C494, Type A, D, and E. Only use admixtures which have been tested and accepted in mix designs, unless otherwise acceptable.

FORM MATERIALS:

Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

Exposed Concrete Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces. Use largest practical sizes to minimize form joints.

Unexposed Concrete Surfaces: Suitable material to suit project conditions.

CURING COMPOUND:

Liquid membrane forming curing compound shall comply with ASTM C300, Type I Class A, minimum 22% solids.

JOINT MATERIALS:

Self-Expanding Cork Joint Filler: Provide resilient and non-extruding type premolded cork units complying with ASTM D1752, Type III.

CONCRETE MIX, DESIGN AND TESTING:

Design mix to produce normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (super-plasticizer), air-entraining admixture and water to produce the following properties:

Compressive Strength: 3000 psi, minimum at 28 days, unless otherwise indicated.

Slump Range: Not greater than 3".

Air Content: 5% plus or minus 1.5%.

PART 3 - EXECUTION

SUBSURFACE PREPARATION:

Remove loose material from compacted subbase surface immediately before placing aggregate base course. No aggregate base course shall be placed until the foundation has been inspected and approved by the Engineer.

Place aggregate base course material on prepared subgrade in layers of uniform thickness. Grade the base course evenly to thickness indicated on drawings and compact before placing concrete.

FORM CONSTRUCTION:

Set forms to required grades and lines, rigidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

Check completed formwork for grade and alignment to following tolerances.

Top of forms not more than 1/8" in 10'.

Vertical face on longitudinal axis, not more than 1/4" in 10'.

Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

CONCRETE PLACEMENT:

General: Comply with requirements of Division-3 sections for mixing and placing concrete, and as herein specified.

Do not place concrete until subbase and forms have been checked for line and grade. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2-hour, place a construction joint.

Drop top of curb as shown in details of plans at all radii of intersections, to allow construction of handicapped ramps and sidewalks.

Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades finish, and jointing as specified.

JOINTS:

General: Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

Weakened-Plane (Contraction) Joints: Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:

Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.

Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

Construction Joints: Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2-hour, except where such placements terminate at expansion joints.

Construct joints as shown or, if not shown, use standard metal keyway-section forms.

Locate expansion joints at 90' o/c. for each curb and gutter section and 50' o/c. for each sidewalk section unless otherwise indicated, and at beginning and end of all curb and gutter radii, connections with rigid objects including existing curb and gutter and catch basins.

Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.

Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or slip joint filler sections together.

Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

Fillers and Sealants: Comply with manufactures requirements for preparation of joints, materials installation, and performance. Place at all curb and gutter template joints.

CONCRETE FINISHING:

After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

Broom finish, by drawing a fine-hair broom across concrete surface, perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Engineer.

Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Engineer.

CURING:

Protect and cure finished concrete paving, complying with applicable requirements of Division-3

sections. Use membrane-forming curing and sealing compound or approved moist-curing methods.

REPAIRS AND PROTECTIONS:

Repair or replace broken or defective concrete, as directed by Engineer.

Drill test cores where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

Sweep concrete and wash free of stains, discolorations, dirt and other foreign material just prior to final inspection.

END OF SECTION 321313

SECTION 323113 - CHAIN LINK FENCES AND GATES

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. Chain-link fences.
 - 2. Horizontal-slide, motor-operated gates.
 - 3. Privacy slats.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Accessories: Privacy slats.
 - d. Gates and hardware.
 - e. Gate operators, including operating instructions and motor characteristics.
- B. Shop Drawings: For each type of fence and gate assembly.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include accessories, hardware, gate operation, and operational clearances.
 - 3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of factory-applied finish.
- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
 - 1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
 - 1. Design Wind Load: As indicated on Drawings.
 - a. Minimum Post Size: Determine according to ASTM F1043 for post spacing not to exceed 10 feet for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
 - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
- C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height: Six foot High.
 2. Steel Wire for Fabric: Wire diameter of 0.192 inch.
 - a. Mesh Size: 2 inches.
 - b. Polymer-Coated Fabric: ASTM F668, Class 1 over zinc-coated steel wire.
 - 1) Color: Black, according to ASTM F934.
 - c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
 3. Selvage: Knuckled at both selvages.

2.3 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
1. Fence Height: 72 inches.
 2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
 - a. Line Post: 4.0 inches in diameter.
 - b. End, Corner, and Pull Posts: 4.0 inches in diameter.
 3. Horizontal Framework Members: Intermediate, top and bottom rails according to ASTM F1043.
 - a. Top Rail: 1.66 inches in diameter.
 4. Brace Rails: ASTM F1043.
 5. Polymer coating over metallic coating.
 - a. Color: Match chain-link fabric, according to ASTM F934.

2.4 TENSION WIRE

- A. Polymer-Coated Steel Wire: 0.177-inch- diameter, tension wire according to ASTM F1664, Class 1 over zinc-coated steel wire.
1. Color: Match chain-link fabric, according to ASTM F934.

2.5 HORIZONTAL-SLIDE GATES

- A. General: ASTM F1184 for gate posts and double sliding gate types. Provide automated vehicular gates according to ASTM F2200.

1. Classification: Type II Cantilever Slide, Class 1 with external roller assemblies.
 - a. Gate Frame Width and Height: More than 48 inches wide by any height As indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Protective coating and finish to match fence framework.
2. Gate Posts: ASTM F1184. Provide round tubular steel posts.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hangers, Roller Assemblies, and Stops: Fabricated from mill-finished Grade 319 aluminum-alloy casting with stainless-steel fasteners.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.

2.6 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.

2.7 PRIVACY SLATS

- A. Fiber-Glass-Reinforced Plastic Slats: UV-light-stabilized fiber-glass-reinforced plastic, not less than 0.06 inch thick, sized to fit mesh specified for direction indicated, with vandal-resistant fasteners and lock strips.
- B. Color: Black.

2.8 GATE OPERATORS

- A. Operators: Factory-assembled, automatic, gate-operating system designed for gate size, type, weight, and frequency of use. Control system shall have characteristics suitable for Project conditions, with control stations, safety devices, and weatherproof enclosures.
 1. Operator design shall allow for removal of cover or motor without disturbing limit-switch adjustment and without affecting auxiliary emergency operation.
 2. Electronic components shall have built-in troubleshooting diagnostic feature.
 3. Unit shall be designed and wired for both right-hand/left-hand opening, permitting universal installation.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. UL Standard: Manufacture and label gate operators according to UL 325.
- D. Motors: Comply with NEMA MG 1.
 1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
 2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 3. Service Factor: 1.15.
 4. Electrical Characteristics:
 - a. Horsepower: 2 Insert horsepower.
 - b. Voltage: 208 V ac, three phase, 60 hertz.
- E. Gate Operators: Pedestal post mounted and as follows:
 1. Mechanical Slide Gate Operators:
 - a. Duty: Heavy duty, commercial/industrial.
 - b. Gate Speed: Minimum 45 feet per minute.
 - c. Maximum Gate Weight: 800 lb.
 - d. Frequency of Use: 25 cycles per hour.
 - e. Operating Type: Wheel and rail drive,.
 - f. Drive Type: V-belt and chain-and-sprocket reducers, roller-chain drive.

- F. Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA 250, Type 3R enclosure for pedestal mounting and with space for additional optional equipment.
- G. Control Devices:
1. Card Reader: Functions only when authorized card is presented. Programmable, magnetic multiple-code system, permitting four different access time periods; face-lighted unit fully visible at night.
 - a. Reader Type: Proximity.
 - b. Features: Timed anti-passback. Limited-time usage. Capable of monitoring and auditing gate activity.
 2. Vehicle Loop Detector: System that includes automatic closing timer with adjustable time delay before closing and loop detector designed to hold gate open until traffic clears. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, and as recommended in writing by detection system manufacturer for function indicated.
 - a. Loop: Field-assembled wire, in size indicated, for pave-over installation.
 3. Vehicle Presence Detector: System that includes automatic closing timer with adjustable time delay before closing and presence detector designed to hold gate open until traffic clears.
 - a. Provide retroreflective detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
- H. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
 2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
 3. Photoelectric/Infrared Sensor: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- I. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully open and fully closed positions.
- J. Emergency Release Mechanism: Quick-disconnect release of operator drive system, permitting manual operation if operator fails. Control circuit power is disconnected during manual operation.
- K. Operating Features:
1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
 2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
 3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
 4. Automatic Closing Timer: With adjustable time delay before closing.

5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: 24 hour, programmable for regular events.

L. Accessories:

1. External electric-powered solenoid lock with delay timer allowing time for lock to release before gate operates.
2. Instructional, Safety, and Warning Labels and Signs: Manufacturer's standard for components and features specified.
3. Equipment Bases/Pads: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

2.9 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.10 GROUNDING MATERIALS

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
 - 1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
 - b. Concealed Concrete: Place top of concrete 2 inches below grade to allow covering with surface material.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 10 feet maximum o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
 - 1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
- L. Privacy Slats: Install slats in direction indicated, securely locked in place.
 - 1. Diagonally for privacy factor of 80 to 85.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GATE-OPERATOR INSTALLATION

- A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.
- C. Vehicle Loop Detector System: Bury wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- D. Ground electric-powered motors, controls, and other devices according to NFPA 70 and manufacturer's written instructions.

3.6 GROUNDING AND BONDING

- A. Fence and Gate Grounding:
 - 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 - 2. Install ground rods and connections at maximum intervals of 1500 feet.
 - 3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 - 4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet on each side of crossing.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.

- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
 - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- E. Connections:
 - 1. Make connections with clean, bare metal at points of contact.
 - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 4. Make above-grade ground connections with mechanical fasteners.
 - 5. Make below-grade ground connections with exothermic welds.
 - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.
- G. Comply with requirements in Section 264113 "Lightning Protection for Structures."

3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
 - 1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
 - 2. Test and adjust operators, controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Lubricate operator and related components.
- C. Lubricate hardware and other moving parts.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 329100 - EROSION AND POLLUTION CONTROL

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of the work required under this section is that required to minimize water, air, and noise pollution and soil erosion and siltation.

Temporary erosion control measures which may be necessary include, but are not limited to, temporary berms, dikes, dams, drainage ditches, silt basins, silt ditches, perimeter swales, slope drains, structures, vegetation, mulches, mats, netting, gravel or any other methods or devices that are necessary to control or restrict erosion. Temporary erosion control measures may include work outside the right-of-way or construction limits where such work is necessary as a result of construction such as borrow pit operations, haul roads, plant sites, equipment storage sites, and disposal of waste or debris. The Contractor shall be liable for all damages to public or private property caused by silting or slides originating in waste areas furnished by the Contractor.

Related Work Specified Elsewhere:

Earth Moving: Section 312000
Turf and Grasses: Section 329200

QUALITY ASSURANCE:

Codes and Standards:

North Carolina Sedimentation Pollution Control Act of 1973 and the Rules and Regulations promulgated pursuant to the provisions of said act.

"Standard Specifications for Roads and Structures", North Carolina Department of Transportation (DOT).

In the event of conflict between the regulations listed above and the requirements of these specifications, the more restrictive requirement shall apply.

SANCTIONS:

Failure of the Contractor to fulfill any of the requirements of this section may result in the Owner ordering the stopping of construction operations in accordance with SUBARTICLE 13.8 of the General Conditions until such failure has been corrected. Such suspension of operations will not justify an extension of contract time nor additional compensation.

Failure on the part of the Contractor to perform the necessary measures to control erosion, siltations, and pollution will result in the Engineer notifying the Contractor to take such measures. In the event that the Contractor fails to perform such measures within 24 hours after receipt of such notice, the Owner may suspend the work as provided above, or may proceed to have such measures performed with other forces and equipment, or both. The cost of such work performed by other forces will be deducted from monies due the Contractor on his contract.

PART 2 - PRODUCTS

SILT FENCES:

Posts: Steel posts shall be 5' in height and be of the self-fastener angle steel type.

Posts shall be spaced at 10' max. when silt fence is backed with wire mesh, and 7' when no wire mesh is used or as required by the Engineer.

Woven Wire: Woven wire fencing shall conform to ASTM A116 for Class 3 galvanizing. Fabric shall be a minimum of 32" in width and shall have a minimum of 6 line wires with 12" stay spacing. The top and bottom wires shall be 10 gauge while the intermediate wires shall be 12-1/2 gauge. Wire fabric shall be fastened to wood posts with not less than #9 wire staples 1-1/2" long.

Fabric: Provide woven synthetic fiber designed specifically for silt fence conforming to NCDOT specifications.

DRAINAGE STONE:

Class I material NCDOT No. 57.

TEMPORARY SEEDING:

Temporary seeding, when required, shall be performed in accordance with the recommendations contained in "Guide for Sediment Control on Construction Sites in North Carolina", published by the Soil Conservation Service and Section 02920 of these specifications.

PART 3 – EXECUTION

GENERAL:

The Contractor shall take whatever measures are necessary to minimize soil erosion and siltation, and water, air, and noise pollution caused by his operations. The Contractor shall also comply with the applicable regulations of all legally constituted authorities relating to pollution prevention and control. The Contractor shall keep himself fully informed of all such regulations which in any way affect the conduct of the work, and shall at all times observe and comply with all such regulations. In the event of conflict between such regulations and the requirements of the specifications, the more restrictive requirements shall apply.

EROSION AND SILTATION CONTROL:

The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property.

Prior to suspension of operations on the project or any portion thereof, the Contractor shall take all necessary measures to protect the construction area, including but not limited to borrow sources, soil type base course sources, and waste areas, from erosion during the period of suspension.

Provide diversion ditches and berms as necessary to prevent concentrated flow of water across disturbed areas.

Stockpile excavated material on the opposite side of the utility trenches from the watercourses to the extent that is possible.

In the event that stockpiles are placed on the watercourse side of the trench, provide silt fence or silt berms with stone filter outlets along the entire length of the stockpile that is on the watercourse side of the trench. Upon the completion of backfilling, the measures shall be removed and the site graded to its natural grade or as shown on plans.

Maintain natural buffer zones along all watercourses sufficient to retain all visible siltation within the first 25 percent of the buffer width.

Provide a settling basin with a gravel filter outlet for all water pumped from trenches or dewatering equipment. Pumping of that water directly into any stream, pond, or watercourse is prohibited.

Tamp, fertilize, seed and mulch the disturbed areas as soon as practicable after line is installed and, in all cases, no later than 30 days after completion of the line segment or work at a particular site.

When construction operations are suspended for more than 30 days, provide temporary seeding and mulching of all disturbed areas including those areas in which further construction is necessary.

Erosion control measures installed by the Contractor shall be acceptably maintained by the Contractor.

Silt fences shall be provided where shown on the drawings and/or as necessary to prevent erosion.

Catch basins and Drop Inlets shall be protected from silt by placing rock inlet sediment traps around the openings until vegetative cover is established.

Temporary rock check dams shall be constructed where shown on the drawings.

Seeding for erosion control shall be performed in accordance with Section 02920.

Stream Or Ditch Crossings shall be perform in accordance with details shown on plans. Complete crossing in one working day. Carefully stabilize disturbed slopes by tamping with equipment buckets and mechanical or hand tamping. Distribute topsoil evenly on slopes and tamp.

Where rip rap is required, carefully place at least one foot thick over filter cloth.

Fertilize, seed, and mulch each crossing's slopes as soon as practicable after completing the crossing and in no case more than two weeks after disturbance of the slopes.

Skimmer Basin with Baffles:

Description

Provide a skimmer basin to remove sediment from construction site runoff at locations shown in the erosion control plans. See the Skimmer Basin with Baffles Detail sheet provided in the erosion control plans. Work includes constructing sediment basin, installation of temporary slope drain pipe and coir fiber baffles, furnishing, installation and cleanout of skimmer, providing and placing stone pad on bottom of basin underneath skimmer device, providing and placing a geotextile spillway liner, providing coir fiber mat stabilization for the skimmer outlet, disposing of excess materials, removing temporary slope drain, coir fiber baffles, geotextile liner and skimmer device, backfilling basin area with suitable material and providing proper drainage when basin area is abandoned.

Materials

<i>Item</i>	<i>Section</i>
<i>Stone for Erosion Control, Class B</i>	<i>1042</i>
<i>Geotextile for Soil Stabilization, Type 4</i>	<i>1056</i>
<i>Fertilizer for Temporary Seeding</i>	<i>1060-2</i>
<i>Seed for Temporary Seeding</i>	<i>1060-4</i>
<i>Seeding and Mulching</i>	<i>1060-4</i>
<i>Matting for Erosion Control</i>	<i>1060-8</i>
<i>Staples</i>	<i>1060-8</i>

Coir Fiber Mat	1060-14
Temporary Slope Drain	1622-2
Coir Fiber Baffle	1640

Provide appropriately sized and approved skimmer device.

Provide Schedule 40 PVC pipe with a length of 6 ft. to attach to the skimmer and the coupling connection to serve as the arm pipe. For skimmer sizes of 2.5 in. and smaller, the arm pipe diameter shall be 1.5 inches. For skimmer sizes of 3 in. and larger, refer to manufacturer recommendation.

Provide 4" diameter Schedule 40 PVC pipe to attach to coupling connection of skimmer to serve as the barrel pipe through the earthen dam.

The geotextile for the spillway liner shall meet the following minimum physical properties for low permeability, woven polypropylene geotextiles:

<u>Property</u>	<u>Test Method</u>	<u>Value</u>	<u>Unit</u>
Tensile Strength	ASTM D-4632	315	lb.
Tensile Elongation (Maximum)	ASTM D-4632	15	%
Trapezoidal Tear	ASTM D-4533	120	lbs.
CBR Puncture	ASTM D-6241	900	lbs.
UV Resistance (% retained at 500 hrs.)	ASTM D-4355	70	%
Apparent Opening Size (AOS)	ASTM D-4751	40	US Std. Sieve
Permittivity	ASTM D-4491	0.05	sec ⁻¹
Water Flow Rate	ASTM D-4491	4	gal/min/ft ²

Anchors: Staples, stakes, or reinforcement bars shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes 12"- 24" long with a 2" x 2" nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving through the coir fiber mat and down into the underlying soil. The other end of the stake needs to have a 1"- 2" long head at the top with a 1"- 2" notch following to catch and secure the coir fiber mat.

Steel Reinforcement Bars:

Provide uncoated #10 steel reinforcement bars 24" nominal length. The bars shall have a 4" diameter bend at one end with a 4" straight section at the tip to catch and secure the coir fiber mat.

Staples:

Provide staples made of 0.125" diameter new steel wire formed into a u shape not less than 12" in length with a throat of 1" in width.

Construction Methods

Excavate basin according to the erosion control plans with basin surface free of obstructions, debris, and pockets of low-density material. Install temporary slope drain pipe and construct the primary spillway according to the Skimmer Basin with Baffles Detail sheet in the erosion control plans. Temporary slope drain pipe at inlet of basin may be replaced by Type 4 geotextile as directed. Construct the coir fiber baffles according to Roadway Standard Drawings No. 1640.01 and Section 1640 of the Standard Specifications.

Install skimmer device according to manufacturer recommendations. Install 4" Schedule 40 PVC pipe into dam on the lower side of basin 1 ft. from the bottom of the basin and according to the detail, and extend the pipe so the basin will drain. Attach a 6 ft. arm pipe to the coupling connection and skimmer according to manufacturer recommendations. The coupling shall be rigid and non-buoyant and not exceed a diameter of 4" and 12" in length. Attach the rope included with the skimmer to the tee between the vent socket and the tube inlet, and the other end to a wooden stake or metal post. Clean out skimmer device when it becomes clogged with sediment and/or debris and is unable to float at the top of water in skimmer basin. Take appropriate measures to avoid ice accumulation in the skimmer device. Construct a stone pad of Class B stone directly underneath the skimmer device at bottom of basin. The pad shall be a minimum of 12" in height, and shall have a minimum cross sectional area of 4 ft. by 4 ft.

Line primary spillway with low permeability polypropylene geotextile unrolled in the direction of flow and lay smoothly but loosely on soil surface without creases. Bury edges of geotextile in a trench at least 5" deep and tamp firmly. If geotextile for the primary spillway is not one continuous piece of material, make horizontal overlaps a minimum of 18" with upstream geotextile overlapping the downstream geotextile. Secure geotextile with eleven gauge wire staples shaped into a u shape with a length of not less than 12" and a throat not less than 1" in width. Place staples along outer edges and throughout the geotextile a maximum of 3 ft. horizontally and vertically. Geotextile shall be placed to the bottom and across the entire width of the basin according to the Skimmer Basin with Baffles detail. Place sealant inside basin around barrel pipe on top of geotextile with a minimum width of 6 in.

At the skimmer outlet, provide a smooth soil surface free from stones, clods, or debris that will prevent contact of the coir fiber matting with the soil. Unroll the matting and apply without stretching such that it will lie smoothly but loosely on the soil surface. Wooden stakes, reinforcement bars, or staples may be used as anchors in accordance with the details in the plans and as directed. Place anchors across the matting at the ends approximately 1 ft. apart. Place anchors along the outer edges and down the center of the matting 3 ft. apart.

All bare side slope sections of the skimmer basin shall be seeded with a temporary or permanent seed mix as directed and in accordance with Articles 1620-3, 1620-4, 1620-5, 1660-4, 1660-5 and 1660-7 of the Standard Specifications. Straw or excelsior matting shall be installed on all

bare side slope sections immediately upon the completion of seeding and in accordance with Article 1631-3 of the Standard Specifications.

Coir Fiber Wattles with Polyacrylamide (Pam):

Description

Coir Fiber Wattles are tubular products consisting of coir fibers (coconut fibers) encased in coir fiber netting. Coir Fiber Wattles are used on slopes or channels to intercept runoff and act as a velocity break. Coir Fiber Wattles are to be placed at locations shown on the plans or as directed. Installation shall follow the detail provided in the plans and as directed. Work includes furnishing materials, installation of coir fiber wattles, matting installation, PAM application, and removing wattles.

Materials

Coir Fiber Wattle shall meet the following specifications:

<i>100% Coir (Coconut) Fibers</i>	
<i>Minimum Diameter</i>	<i>12 in.</i>
<i>Minimum Density</i>	<i>3.5 lb/ft³ +/- 10%</i>
<i>Net Material</i>	<i>Coir Fiber</i>
<i>Net Openings</i>	<i>2 in. x 2 in.</i>
<i>Net Strength</i>	<i>90 lbs.</i>
<i>Minimum Weight</i>	<i>2.6 lbs./ft. +/- 10%</i>

Anchors: Stakes shall be used as anchors.

Wooden Stakes:

Provide hardwood stakes a minimum of 2-ft. long with a 2 in. x 2 in. nominal square cross section. One end of the stake must be sharpened or beveled to facilitate driving down into the underlying soil.

Matting shall meet the requirements of Article 1060-8 of the Standard Specifications, or shall meet specifications provided elsewhere in this contract.

Provide staples made of 0.125" diameter new steel wire formed into a u shape not less than 12" in length with a throat of 1" in width.

Polyacrylamide (PAM) shall be applied in powder form and shall be anionic or neutrally charged. Soil samples shall be obtained in areas where the wattles will be placed, and from offsite material used to construct the roadway, and analyzed for the appropriate PAM flocculant to be utilized with each wattle. The PAM product used shall be listed on the North Carolina

Department of Environmental Quality Division of Water Resources web site as an approved PAM product for use in North Carolina.

Construction Methods

Coir Fiber Wattles shall be secured to the soil by wire staples approximately every 1 linear foot and at the end of each section of wattle. A minimum of 4 stakes shall be installed on the downstream side of the wattle with a maximum spacing of 2 linear feet along the wattle, and according to the detail. Install a minimum of 2 stakes on the upstream side of the wattle according to the detail provided in the plans. Stakes shall be driven into the ground a minimum of 10 in. with no more than 2 in. projecting from the top of the wattle. Drive stakes at an angle according to the detail provided in the plans.

Only install coir fiber wattle(s) to a height in ditch so flow will not wash around wattle and scour ditch slopes and according to the detail provided in the plans and as directed. Overlap adjoining sections of wattles a minimum of 6 in.

Installation of matting shall be in accordance with the detail provided in the plans, and in accordance with Article 1631-3 of the Standard Specifications, or in accordance with specifications provided elsewhere in this contract.

Apply PAM over the lower center portion of the coir fiber wattle where the water is going to flow over at a rate of 2 ounces per wattle, and 1 ounce of PAM on matting on each side of the wattle. PAM applications shall be done during construction activities after every rainfall event that is equal to or exceeds 0.50 in.

The Contractor shall maintain the coir fiber wattles until the project is accepted or until the wattles are removed, and shall remove and dispose of silt accumulations at the wattles when so directed in accordance with the requirements of Section 1630 of the Standard Specifications.

WATER AND AIR POLLUTION:

The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent pollution of rivers, streams, and water impoundments. Pollutants such as chemicals, fuels, lubricants, bitumens, raw sewage, and other harmful waste shall not be discharged into or alongside of rivers, streams, or impoundments, or into natural or manmade channels leading thereto.

The Contractor shall comply with all State or local air pollution regulations throughout the life of the project.

DUST CONTROL:

The Contractor shall control dust throughout the life of the project within the project area and at all other areas affected by the construction of the project, including, but not specifically limited to,

unpaved secondary roads, haul roads, access roads, disposal sites, borrow and material sources, and production sites. Dust control shall not be considered effective where the amount of dust creates a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property.

NOISE CONTROL:

The Contractor shall exercise every reasonable precaution throughout the life of the project to prevent excessive and unnecessary noise. The Contractor shall choose his methods so as to minimize the disturbance of area residents.

END OF SECTION 329100

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

Sodding is required for all areas designated on the Planting Plan.

Permanent Seeding: Permanent seeding is required for all areas disturbed by construction, except for areas covered by structures, pavements, sod, etc.

Temporary Seeding: Temporary seeding of disturbed areas shall be performed whenever one or more of the following conditions exist.

The Engineer determines temporary seeding is necessary to prevent or stop erosion of disturbed areas.

Work is suspended or delayed on any portion of the project for 21 calendar days.

Whenever permanent seeding is delayed beyond that required by the Contract Documents.

QUALITY ASSURANCE:

Codes and Standards: In general, follow procedures and guides published by the Soil Conservation Service, United States Department of Agriculture.

PART 2 - PRODUCTS

FERTILIZER:

Provide commercial fertilizer conforming to statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

LIMESTONE:

Provide agricultural limestone conforming to all statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

SOD:

The grass sod shall be Centipede grass and shall come from a field that is very sandy with a maximum of 10% silt and clay combined. Sod from a field of heavy soil will not be accepted. The sod shall be free of foreign grasses, other bermuda strains, weeds and noxious nematodes. The sod shall be mowed to a uniform height of 3/4 inch for a minimum of two weeks prior to harvest. The sod shall be cut with a soil layer of approximately 1 inch rootmat. The sod shall be harvested, delivered and transplanted within a period of 48 hours.

SEED:

Provide seed conforming to all statutory requirements and all rules and regulations adopted by the North Carolina Board of Agriculture.

Provide seed in accordance with requirements shown below. Deliver to site in original containers, labeled to show that the requirements of the N.C. Seed Law are met.

Quality of seed shall conform to the following:

<u>Common Name</u>	<u>Minimum Seed Purity</u> %	<u>Minimum Germination</u> %	<u>Maximum Weed Seed</u> %
<u>Grasses</u>			
Fescue Tall (KY.-31 OR REBELS)	98	90	1.00
Centipede	80	90	1.00

Seeding containing prohibited noxious weed seed shall not be accepted. Seed shall be in conformance with state seed law restrictions for restricted noxious weeds.

If seed of the accepted quality cannot be bought, secure prior approval before making changes or exceptions.

MULCH:

Mulch for erosion control shall consist of grain straw or other acceptable material, and shall have been approved by the Engineer before being used. All mulch shall be reasonably free from mature seedbearing stalks, roots, or bulblets of Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Bermuda Grass, Crotalaria, and Witchweed, and free of excessive amount of restricted noxious weeds as defined by the North Carolina Board of Agriculture at the time of use of the mulch. Also there shall be compliance with all applicable State and Federal domestic plant quarantines. Straw mulch that is matted or lumpy shall be loosened and separated before being used.

Material for holding mulch in place shall be asphalt or other approved binding material applied in accordance with this section.

JUTE MESH:

Use jute mesh on seeded areas where slope is steeper than 2 horizontal to one vertical (2:1 slope). Use woven jute yarn weighing approximately 90 lbs. per 100 sq. yds. and having 3/4" openings.

PART 3 - EXECUTION

GENERAL:

Follow procedures set forth in the publication "Guide for Sediment Control on Construction Sites in North Carolina" by the United States Department of Agriculture, Soil Conservation Service, and as specified herein.

Scarify soil to a depth of three (3) inches and work into a satisfactory seed bed by discing, use of cultipackers, harrows, drags and other approved means.

Preparation outlined above shall not be done when the soil is frozen, wet or otherwise in an unfavorable condition.

Begin and complete seeding operations as outlined below as soon as possible after final grading is completed, but in no event later than 30 days after completion of final grading.

Distribute lime and fertilizer, uniformly over seed bed and harrow, rake, or otherwise work same into seed bed.

Distribute seed uniformly over seed bed. Cover seed lightly after seeding.

No lime, fertilizer, or seed shall be applied during a strong wind, when soil is wet or otherwise unworkable. Should rain follow seeding before rolling is begun, the bed shall not be rolled.

SODDING PROCEDURES

Moistening the Soil: During periods of higher than optimal temperature for species being specified and after all unevenness in the soil surface has been corrected, the soil shall be lightly moistened immediately prior to laying the sod.

Starter Strip: The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and tightly against each other. Lateral joints shall be staggered to promote more uniform growth and strength. Care shall be exercised to insure that the sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause air drying of the roots. Sod shall be cut as required to fit irregular areas. Wheeling sod over prepared sod will not be permitted except over boards or mats.

Sloping Surfaces: On slope areas lay sod with long edge parallel to contour; start at bottom of slope, and peg in place on slopes of 3=1 or greater with at least one peg per square yard.

Watering and Rolling: Contractor shall water sod immediately after transplanting to prevent excessive drying during progress of the work. As sodding is completed in any one section, the entire area shall be rolled. It shall then be thoroughly watered to a depth sufficient that the underside of the new sod pad and soil immediately below the sod are thoroughly wet. The General Contractor shall be responsible for having adequate water available at the site prior to and during transplanting the sod.

Timing: Sod may be installed only between October 01 and April 30. Any installation outside these dates shall be approved by the Project Consultant.

SOD MAINTENANCE

Watering: The Contractor shall provide water daily for the sod as required for a period not less than thirty (30) days after it is laid. Watering shall be applied in a manner that will prevent erosion. Watering equipment shall be of a type that will prevent damage to the finished surface.

First Week: The Contractor shall provide all labor and arrange for all watering necessary for rooting of the sod. Soil on sod pads shall be kept moist at all time. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least 4 inches. Watering should be done during the heat of the day to prevent wilting.

Second and Subsequent Weeks: The Contractor shall water the sod as required to maintain adequate moisture, in the upper 4 inches of soil, necessary for the promotion of deep root growth.

Mowing: The Contractor shall be responsible for the first two mowings, and any other mowing necessary until final inspection. Mowing shall be required when the sod is over 2" tall and shall be mowed to a height of 1½- 2 inches.

The first mowing shall not be attempted until the sod is firmly rooted and secure in place. Not more than 40% of the grass leaf shall be removed by the initial or subsequent mowings.

Any accumulation of clippings shall be removed within 12 hours after mowing.

Corrective Measures

Reworking and resodding of any areas which fail to show evidence of rooting shall be done at Contractor's expense with the same type sod.

It is the Contractor's responsibility to carry out the above operations on a continuing basis until the lawn areas are accepted by the Project Consultant.

In the event the required maintenance period extends beyond 30 days, the Contractor will be responsible for fertilizing, weeding, and other pest control, if required, in addition to watering and mowing.

PERMANENT SEEDING:

Application of Lime, Fertilizer and Seed:

Apply lime at the rate of 2 tons per acre. (NOTE: Lime application shall be adjusted for PH as recommended by USDA Soil Conservation

Apply fertilizer at a rate of 500 pounds per acre or at a rate at which will provide the following amounts of nutrients:

Nitrogen:	100 pounds per acre
Potash:	100 pounds per acre
Phosphorous:	100 pounds per acre

Apply 600 pounds per acre of 20% superphosphate or equivalent in addition to that listed above or use an analysis which will provide the additional phosphorous.

Provide permanent seeding within the site for areas not sodded in accordance with the following schedule:

Tall Fescue	250 pounds per acre
Centipede	25 pounds per acre

TEMPORARY SEEDING:

Seed in accordance with Soil Conservation Service recommendations with regard to seed type, rate of application, fertilizer, etc.

APPLICATION OF MULCH:

Apply mulch immediately after permanent seeding at a uniform rate sufficient to achieve approximately 80% coverage of ground surface. Care must be taken to prevent the mulch from being applied too thickly and smothering the seedlings. Mulch for temporary seeding should be applied based upon the recommendations of the Soil Conservation Service for the particular type of seed to be used.

Mulch Anchoring:

On ground slopes less than 4%, anchor mulch with a straight blade disk or anchoring tool. Press mulch into soil about three inches. Operate equipment across slopes.

On ground slopes greater than 4%, apply asphalt with suitable applicator at a rate of not less than 150 gallons per ton of mulch.

Peg and twine anchoring may be used on steep slopes. Drive 8" wood stakes every 3 to 4 feet in all directions. Stretch in a crisscross and square in all directions. Secure twine around pegs and drive pegs flush with surface.

REPAIR AND MAINTENANCE:

Maintain the grass on the area for a period of 90 days after the grass growth appears. Reseed bare areas and repair all eroded areas during that period.

Repairs: Inspect all seeded areas and make necessary repairs or reseedings within the planting season, if possible. If stand should be over 60% damaged, reestablish following original lime, fertilizer and seeding recommendations.

All areas which do not exhibit satisfactory ground cover within 45 days of seed application shall be replanted.

END OF SECTION 329200

SECTION 330500 – COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division 1 - Specification sections apply to work of this section. Work shall be done in accordance with AHJ Design Manual. All references to Owner and Engineer shall imply AHJ and their representatives.

DESCRIPTION OF WORK:

Work under this section includes all material certificates; shop drawings; disinfection of all wetted parts of the total system; and field testing of all pipe, pipe fittings, piping specials, and valves in all sections of Division 33 necessary to complete and make serviceable the water supply system.

Related Work Specified Elsewhere:

Water Pipe and Pipe Fittings - Section 332110

Water Pipe Accessories - Section 332130

Water Valves - Section 332120

Water Services – Section 332140

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

North Carolina Division of Health Services: All rules and regulations

AHJ Design Manual

PART 2 - PRODUCTS - None

PART 3 - EXECUTION

DISINFECTION OF NEW WATER SYSTEMS:

Before being placed into service, and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extensions, or any replacement in the existing water system, or any exposed section of the existing system shall be disinfected as follows:

DISINFECTION OF NEW SYSTEMS

(a) All interior surfaces of new potable water supply systems, including wells, filters, storage tanks and distribution lines shall be thoroughly disinfected by means of hypochlorite or chlorine solutions, after which bacteriological test samples shall be collected.

(b) After disinfection the water supply shall not be placed into service until bacteriological test results of representative water samples analyzed in an approved laboratory are found to be satisfactory.

DISINFECTION OF STORAGE TANKS AND DISTRIBUTION SYSTEMS

(a) Water distribution systems, including storage tanks and water mains, after flushing to remove sediment and other foreign matter, and after testing for leaks, shall be disinfected by the addition and thorough dispersion of a chlorine solution in concentrations sufficient to produce a chlorine residual of at least 100 milligrams per liter (or ppm) in the water throughout the distribution system, including all water mains and storage tanks.

(b) The chlorine solution shall remain in contact with interior surfaces of the water system for a period of 24 hours. Then the water system shall be flushed with fresh water from an approved water source until the chlorine solution is dispelled.

(c) Representative samples of the water shall then be collected. If bacteriological tests of the samples indicate that the water quality is satisfactory, the water mains and storage tanks may be placed in service.

(d) In unusual situations where large volume tanks are involved and where there is not sufficient water available to fill the tank or there is not available a suitable drainage area for the chlorinated water, an alternate disinfection procedure for tanks may be proposed. Such proposal must be submitted in writing completely describing the proposed disinfection procedure and substantiating the need for an alternate procedure in the particular circumstance. Such alternate procedure must be approved before being implemented. The conclusion of the department shall be final."

The Contractor shall be required to make arrangements for having tests conducted. All expenses incurred in making tests shall be borne by the Contractor and should be included in his bid.

TESTING NEW WATER LINES:

The following test sequence shall be included in all water system extension specifications unless otherwise directed by the Engineer.

- (1) Perform pretest inspection.
- (2) Clean the main.

- (3) Perform the hydrostatic tests.
- (4) Apply the proper dosage of chlorine.
- (5) Allow chlorine solution to remain in the water main a minimum of 24 hours.
- (6) Flush the main.
- (7) Assist the Owner in taking bacteriological samples.

Pretest Inspection:

Prior to the commencement of hydrostatic testing and chlorination, the Engineer shall be contacted to request scheduling of inspection and testing. A Engineer's Representative shall visually inspect the installation prior to testing to insure that all fire hydrants, valves and other appurtenances are properly located, operable, and installed at the proper grade. All defects disclosed by the inspection shall be corrected prior to testing.

Cleaning Of The Main:

Cleaning of Water Mains 4" and Smaller in Diameter: Mains smaller than 4" in diameter shall be cleaned by flushing. Flushing velocity shall be adequate to remove all debris and other undesirable material and a minimum of 2-1/2 feet per second.

Cleaning of Water Mains 4" and Larger in Diameter: Mains shall be flushed only in the presence of Owner's Representative. No valves or hydrants shall be operated without the express permission of the Owner.

Cleaning shall be accomplished by passing through the pipe a polyethylene "pig" of the appropriate size and density (as manufactured by Poly-Pig or approved equal). Pig(s) shall be furnished by the Contractor. The procedure shall be as follows:

- A. The Contractor shall prepare the main for the installation and removal of pig(s) as required:
 1. In general, this will consist of furnishing all equipment, material, and labor to satisfactorily install and remove the pig(s).
 2. Prior to scheduling a preconstruction conference, the Contractor shall submit a "pigging" plan to the Engineer for approval.
 3. Where expulsion of the pig is required through a dead end main, Contractor shall prevent the backflow of purged water into the main after expulsion of the pig. For pipe 12" or less in diameter, purged water can be prevented from reentering into the pipe by the temporary installation of pipe and fittings as required to provide a riser with an above ground discharge. On larger pipe, additional excavation of the trench may serve the same purpose.
 4. After expulsion of the pig, completion of flushing, and at the direction of the Engineer, the Contractor shall complete work at openings by plugging, blocking, backfilling and completion of all appurtenant work necessary to secure the system.

- B. Under the supervision of the Inspector, pig(s) shall be propelled via water pressure through the main(s) from the point of insertion to the point of expulsion. Where mains are in the form of a loop, the Contractor shall “pig” the complete system.
- C. As an alternate to “pigging”, dead end pipe of less than 100 feet in length which are difficult to “pig” may be cleaned by flushing. Flushing shall be accomplished in the same manner as that required for pipes less than four inches in diameter.

Hydrostatic Test:

Unless otherwise permitted, testing shall be performed between each main line valve in accordance with AWWA C600. The Owner will, except when certain circumstances dictate otherwise, permit the lengths of test sections to be a maximum of 1500 feet in subdivisions or other areas where the new main has closely spaced valves. Testing shall be done only in the presence of Owner's Representative unless directed otherwise. Testing shall be performed using a suitable pump and an accurate gauge graduated in 1.0 psi increments. The section of the main to be tested shall be subjected to a test pressure of 150 psi for a period of two (2) hours. The leakage of the test section shall be accurately determined and compared to the schedule shown below. All visible leaks shall be repaired regardless of the amount of leakage.

PIPE SIZE (inches)	ALLOWABLE LEAKAGE (Gallons per hour per 1000 feet of pipe)
2	0.16
4	0.33
6	0.50
8	0.66
10	0.83
12	0.99
14	1.29
16	1.47
18	1.66
20	1.84

If the leakage is greater than the allowable leakage as given by the above table, the Contractor shall replace any defective materials and perform all necessary work to insure that the installation is acceptable and a retest shall be performed subsequent to any repair work performed. Remedial repair work and retesting shall be repeated until the leakage occurring during the test period is less than or equal to the allowable leakage.

Chlorination:

Chlorination shall be performed only in the presence of Owner's Representative and shall be performed only after the line is complete and has tested satisfactorily for leakage.

Chlorination taps will be made within five (5) pipe diameters of the water main control valve at the upstream end of the line and at all extremities of the line.

Sufficient chlorine solution shall be applied to bring the concentration within the main to a minimum of 100 ppm free chlorine residual.

The chlorine solution shall be introduced to the main at a constant rate while regulating the flow of water through the main being chlorinated such that the required concentration of chlorine is achieved throughout.

All valves within the section of main being chlorinated shall be operated once during the contact period.

The chlorine solution shall remain in the lines for no less than twenty-four (24) hours, longer if so directed by the Engineer.

Services shall be chlorinated at the same time and by the same method utilized for the main. Extreme care shall be taken to prevent contamination of existing water mains during the test period. If an existing main is contaminated, the section of main subjected to the possible contamination shall be flushed and chlorinated in accordance with the requirements for new mains.

The Engineer will advise the Contractor when a suitable period of time has elapsed for chlorine contact. The main shall be flushed thereafter in the presence and under the direction of the Owner's Representative. The flushing of the main shall be considered complete when the chlorine concentration with the main is less than or equal to the lesser of the following values:

One (1) part per million (ppm) free chlorine.

The free chlorine concentration within the existing main to which the extension has been connected.

The Contractor shall be responsible for insuring that high-strength chlorine solution is contained on-site and not allowed to make its way to any watercourse, stream, creek, lake, or other body of water.

Bacteriological Testing:

After completion of chlorination and flushing, the Contractor shall assist the Owner as necessary in obtaining sufficient bacteriological samples for complete testing.

The Owner shall determine the location of samples and the number of samples necessary to provide a test group which is representative of the section of main being tested.

A failure of any sample of a test group shall constitute failure of the entire test group from which the sample was taken. Such failure shall require two (2) successive passing test groups to substantiate that the main has been satisfactorily chlorinated. The second of the two successive test groups of samples will not be collected before nor unless the first group has passed.

The Contractor may, at his option, rechlorinate and retest the section of water main upon failure of the test group.

If two (2) successive bacteriological test groups fail, the section of main from which the group is taken shall be rechlorinated and retested until the main is shown to be properly chlorinated in accordance with the above requirements.

END OF SECTION 330500

SECTION 332110 – WATER PIPE AND PIPE FITTINGS

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work under this item includes providing and installing all pipe and pipe fittings as shown on the drawings and described herein necessary to make complete and serviceable the finished water main.

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200

Common Work Results for Utilities: Section 330500

Water Valves: Section 332120

QUALITY ASSURANCE:

General: Class numbers or pressure rating shall be clearly marked on the pipe and fittings at the factory. The materials used for the construction of water mains and all accessories and appurtenances thereof shall be new, free of defects in product and workmanship and of the highest quality available in the industry. Materials not specified but deemed equal to those specified may be approved for use provided the documentation and samples necessary for approval are provided to the Engineer thirty (30) days prior to the ordering of said materials. WRITTEN APPROVAL must be issued by the Engineer before such material may be used in construction. Current specifications (latest revisions) shall apply in all cases where materials are described by reference to published standards such as ASTM, AWWA, ANSI., etc.

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

North Carolina Division of Environmental Management: All rules and regulations

North Carolina Division of Health Services: All rules and regulations.

SUBMITTALS:

Material Certificates: Provide notarized materials certificates signed by the material manufacturer. Certify that each material item complies with the specified requirements, and was purchased for this project.

Shop Drawings: Submit shop drawings on all flanged fittings.

PART 2 - PRODUCTS

Water Main and Fittings: Water mains shall be constructed of polyvinyl chloride (PVC) or ductile iron pipe (DIP) at the option of the Contractor, except in instances where the plans or the Engineer specifically requires a particular pipe material be utilized for an installation. All plastic pipe shall bear the seal of the National Sanitation Foundation.

2" & 3" PVC Pipe: PVC water main and services shall be PVC Class 200 SDR 21 conforming to the latest revisions of ASTM D 1784 and ASTM D2241 with "push-on" joints. Pipe shall be furnished in nominal twenty foot (20') lengths. Fittings for service pipe shall be schedule 80 PVC with solvent weld joints.

PVC Water Mains 4 Inches and Larger in Diameter: PVC water main 4 inches and larger shall be manufactured in accordance with AWWA Standard C900. The pipe shall have push-on type joints with elastomeric gaskets. The pipe shall be pressure rated at 150 psi with a dimension ratio of 18 for both bell and pipe thickness. Pipe shall be furnished in nominal twenty foot (20') lengths.

Ductile Iron Pipe: Ductile iron pipe for water mains shall be manufactured in conformance with AWWA C151 and shall be cement- mortar lined with an asphaltic coating in accordance with AWWA C104. The exterior of the pipe shall be bituminous coated in accordance with AWWA C-151. The minimum thickness Class of pipe shall be Class 50. Pipe shall be furnished in nominal 18 to 20 foot lengths. Pipe joints for ductile iron pipe shall be "push-on" unless the additional pipe deflection allowed by mechanical joints is necessary or other considerations dictate the use of mechanical joints. The joints for ductile iron pipe shall conform to AWWA Standard C111 revision (ANSI A21.11).

Polyethylene Encasement: Polyethylene encasement shall be applied to all underground ductile iron pipe and fitting installations. Materials and installation procedures shall be in accordance with ANSI/AWWA C-105/A21.5-88.

Fittings: Tees, elbows and other fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron unless otherwise permitted or required by the Owner. Standard dimension fittings or compact fittings may be used in accordance with the requirements of this Section.

The interior of all fittings shall be cement mortar lined with an asphaltic coating in accordance with AWWA Standard C-104 (ANSI 21.4). The exterior of all fittings shall have a one (1) mil bituminous coating in accordance with AWWA Standard C-110 (ANSI A21.10).

Compact fittings shall be ductile iron with either push-on or mechanical joints in accordance with ANSI/AWWA C153/A21.53-84. Cement lining with an asphaltic coating shall be provided in accordance with ANSI/AWWA C104/A21.4.

"Push-on" joints shall be used unless the additional deflection allowed by mechanical joints or other considerations dictate the use of mechanical joints.

Standard dimension fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron with "push-on" joints unless the additional pipe deflection allowed by mechanical joints or other considerations dictate the use of mechanical joints. The fittings shall comply with all requirements of AWWA Standard C-110 (ANSI A21.10) and shall be designed for a minimum working pressure of 150 psi plus 100 psi surge pressure.

Restraint devices for use on ductile iron and C-900 PVC "push-on" joints: shall be constructed of high strength ductile iron, ASTM A536, Grade 65-45-12 and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Block Buster Series 1390-C, Star Pipe Products Allgrip series 3600 and Pipe Restrainers Series 1200S, or approved equal.

Restraint devices for use on mechanical joint to C-900 PVC: shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1500, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc GripRing or approved equal.

Restraint devices for use on mechanical joint ductile iron: shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1300-C, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc. GripRing or approved equal.

JOINTS AND JOINTING MATERIALS FOR LARGE PIPE:

General: Where the joint type is not indicated on the drawings, either push-on or mechanical joints shall be furnished for buried pipe.

Ductile Iron:

Push-on joints shall conform to applicable requirements of AWWA C111 (ANSI A21.11). Gaskets and lubricants for pipe fittings shall conform to applicable requirements of AWWA C111 (ANSI A21.11).

Mechanical joints, including pipe ends, glands, bolts and nuts, and gaskets, shall conform to applicable requirements of AWWA C111 (ANSI A21.11).

Pipe capable of joint deflection of up to 5 degrees per joint shall be provided.

PART 3 - EXECUTION

GENERAL:

Adherence to Standards and Instructions: All pipe, of whatever material, shall be transported, handled, stored, and installed in keeping with applicable AWWA, ASTM etc. standards and manufacturer's instructions for the particular pipe material involved. For PVC piping system, the latest edition of the CHEMTROL PLASTIC PIPING HANDBOOK as published by Celanese Piping Systems, Inc., Louisville, Kentucky, shall be the project reference manual and instructions contained therein shall be followed.

Responsibility for Materials: During loading, transportation, unloading and storage, every precaution shall be taken to prevent injury to pipe, fittings and accessories and to keep them from dirt and foreign matter at all times. Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate specifications.

Provide caps or plugs for open ends of pipe lines and equipment during installation to keep dirt and other foreign matter out of pipe and equipment.

Expansion: All piping mains, branches, and runouts shall be so installed as to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Stresses shall be within allowable limits of ASA Code B31.1 for pressure piping.

EXTERIOR:

General Pipe Laying: All pipe, special castings, valves, fittings, and the bells and/or spigots of same shall be thoroughly cleaned of all earth or other foreign matter before being fitted together. The spigot end shall be adjusted in the bell of the pipe, special casting or valve to allow for uniform gasket space, and the pipe shall be completely forced home and held there.

Prior to being lowered into the trench, each joint of pipe shall be carefully given a final inspection to see that each is clean, sound, and free of defects. Damaged sections shall be repaired to the satisfaction of the Engineer or removed from the Site.

Pipe shall be laid accurately to the line and grade as designated on the job plans. Bell holes shall be excavated for each joint to assure bedding supports the barrel of the pipe and to facilitate making a perfect joint.

Pipe shall be laid in perfect alignment between turns. No abrupt changes, either in grade or alignment, will be acceptable. At such locations where alignment changes are indicated on the plans, fittings and adjacent pipe shall be self restrained by harnesses or special fittings or external blocking. Do not bend or deflect pipe more than recommended by manufacturer.

Cross above or below existing pipe a minimum of 12" unless otherwise directed by the Engineer.

During construction of the line work the lines shall be kept free from debris. Trenches shall be kept free from water; and when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, or other substances will enter the pipe or fittings. At the end of each day's work, the pipe shall be inspected to insure that dirt, water, and other materials have not entered the pipe.

PIPING JOINTS AND CONNECTIONS:

Mechanical Joints: Make up with Style A plain rubber molded gaskets, unless otherwise specified. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed or of the factory-made jointing materials shall be clean and dry. Gaskets, whether for the mechanical joint type or push joint type, shall be clean, flexible, and, where lubrication is required, be lubricated with a lubricant recommended by the manufacturer. Provide special joints capable of up to 5 degrees deflection per joint where shown on the drawings. Do not deflect or bend pipe more than recommended by manufacturer.

CLEANING:

Piping systems shall be thoroughly cleaned as follows:

Flush all pipe lines with clean water and perform visual inspection where possible to achieve a clean piping system clear of all debris, rust and dirt.

THRUST RESTRAINT:

All plugs, caps, tees and bends deflecting 11-1/4 degrees or more shall be provided with reaction blocking of 2,500 psi concrete or suitable metal harness to prevent movement. Blocking shall be placed between solid earth and the fitting to be anchored. The blocking shall be placed such that pipe and fitting joints are accessible for repair and/or future connections. Where space limitations will not permit installation of concrete blocking where necessary to insure accessibility, where shown on the drawings, or if the Contractor so elects, pipe and fittings may be self restrained in addition to or in lieu of concrete blocking. Pipe shall be designed to carry additional stresses of thrust restraint. Details pertinent to such self-restraining harness, tie rods, special pipe, etc., including design criteria and computations, must be submitted to the Engineer for evaluation prior to incorporating such devices into the work. Systems based on metal to metal friction, such as retainer glands, will not be allowed for pressures above 100 psi.

Reaction Backing: The area of bearing of the concrete backing on the earth in each instance shall be at least equal to that shown in the table below. Minimum bearing area against undisturbed sand trench wall in square feet. Details of placement are shown in the drawing.

Areas shown are for 150 psi test pressure. If test pressure is other than 150 psi, adjust area of reaction backing in direct proportion.

Pipe Size	Tees Plugs	Hydrant 90 Degree Els	Wyes 45 Degree Els	Wyes 22-1/2 Degree Els	Wyes 11-1/4 Degree Els
4"	1	2	1	1	1
6"	3	3	2	1	1
8"	4	6	3	2	1
10"	7	9	5	3	2
12"	9	11	6	3	2
14"	11	15	8	5	3
16"	13	20	10	6	3

Areas based on sand; for other soil conditions revise areas as indicated:

- Cemented Sand or Hardpan - multiply above by 0.5
- Gravel - multiply above by 0.7
- Hard Dry Clay - multiply above by 0.7
- Soft Clay - multiply above by 2.0

Muck: Secure all fittings with approved harness or tie rod clamps, with concrete reaction backing the same as listed for sand conditions.

TESTING PIPING SYSTEMS:

See Section 330500

DISINFECTION OF PIPING SYSTEMS:

See Section 330500

END OF SECTION 332110

SECTION 332120 – WATER VALVES

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work covering valves and gates includes furnishing, installing, and making operational all valves and gates as indicated on the drawings and specified herein.

Related Work Specified Elsewhere:

Common Work Results for Utilities: Section 330500

Water Pipe and Pipe Fittings: Section 332110

Water Pipe Accessories: Section 332130

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

SUBMITTALS:

Shop Drawings: Submit shop drawings for all valves, valve boxes, tapping sleeves, and special items.

PART 2 - PRODUCTS

2" Ball Valve: Ball valves for two-inch services shall be bronze body with tee head. The turn required to travel from fully closed to fully open position shall be 90 degrees. Ball valves shall incorporate a check allowing a maximum turn of 90°. Ball valves shall be Hayes 4300, Ford B11-777, A Y McDonald 6101, Mueller B 20283, or approved equal.

Gate Valves (3" and Larger): Gate valves shall conform to the requirements of the latest revision of AWWA Specification C-509/C-515 for resilient seated gate valves. The valve body shall be ASTM A-126 Class B cast iron or ductile iron and shall conform to ASTM A395 or ASTM A536. In addition, ductile iron shall contain no more than 0.08 percent phosphorous. All interior valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counterclockwise and have non-rising stem operation with 2-inch square operating nuts. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have "O" ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have flange connections conforming to ANSI B16.1 Class 125 or mechanical joints conforming to AWWA C-111.

Valves shall be manufactured by Clow, American Flow Control, or Mueller.

Tapping Valves: Tapping valves shall conform to the requirements of the latest revision of AWWA Specification C-509 for resilient seated gate valves. The valve body shall be ASTM A-126 Class B cast iron. All internal valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counterclockwise and have non-rising stem operation with a two inch square operating nut. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have O-ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have a flange connection conforming to ANSI B16.1 Class 125 and a mechanical joint conforming to AWWA C-111. Valves shall be manufactured by Mueller, Clow or American Flow Control. Tapping valves shall be installed and pressure tested prior to tapping the water line.

Valve Boxes (valves 2" through 10"): Valve boxes shall be of cast iron suitable for H-20 loading. The manufacturer's name and part number shall be cast into each component of the box. The box shall be of the telescoping (slip) type consisting of a base section, center extensions as necessary, and a top section with a cover marked "WATER". Sections shall be selected such that a minimum of four inches (4") of future adjustment (upward and downward) will be possible without section removal or replacement and without the use of adapters. Valve boxes and extensions shall be either of the following:

Charlotte Pipe and Foundry: UTL-274 (valve boxes) and UTL-281 (extensions).

Tyler Pipe: 6855 Series (valve box and extensions). Lid shall be 5 1/4" Drop Lid having a minimum of 1 1/2" deep skirt.

Valve boxes shall be installed in accordance with the Standard Details.

Indicator Post: Cast iron indicator posts shall be provided in the locations shown on the drawings. Posts shall have two large window openings that are fitted with heavy clear plexiglass. Aluminum target plates, with the words OPEN and CLOSED cast in large, easy-to-read, raised letters shall be located behind each window in such a position that the appropriate word appears as the valve is operated. Stem, indicators, and all working parts shall be fully protected from moisture and weather damage by complete enclosure. The indicator posts shall be Clow F-5760, Americal Flow Control IP-71, Kennedy Valve Model 2945, or equal.

BACKFLOW PREVENTION ASSEMBLIES

Control assemblies such as reduced pressure principle assemblies and reduced pressure principle detector assemblies shall be limited to those approved by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California.

Double Check Valve Assembly (DCA): The double check valve backflow preventer assembly shall be ASSE® Listed 1048, and supplied with full port gate valves. The main body and access cover shall be epoxy coated ductile iron (ASTM A 536 Grade 4), the seat ring and check valve shall be Noryl™ (NSF listed), the stem shall be stainless steel (ASTM A 276) and the seat disc elastomers shall be EPDM. The first and second check valves shall be accessible for maintenance without removing the device from the line. The double check backflow prevention assembly shall be a FEBCO Model 805, Watts Series 007, Wilkins Model 950XL or equal.

Reduced Pressure Principle Backflow Preventer (RP) and Reduced Pressure Detector Assembly (RPDA): The reduced pressure principle backflow preventer shall be a complete assembly consisting of two independently acting springloaded toggle lever check valves together with an automatically operating pressure differential relief valve located between the two check valves. The first check valve shall reduce the supply pressure a predetermined amount so that during normal flow and the cessation of normal flow, the pressure between the checks is less than the supply pressure. In the case of leakage of either check valve, the differential relief valve shall discharge to atmosphere to maintain the pressure between the checks, less than the supply pressure. The unit shall include tightly closing shutoff valves located at each end of the device, and shall be fitted with four test cocks. Operation shall be completely automatic. All internal parts of the toggle lever check valves and pressure differential relief valve must be removable or replaceable without removal of the backflow preventer assembly from the line. The reduced pressure backflow preventer shall be similar in all respects to the FEBCO Model 825YD (OS&Y), Watts Series 909-OSY, Wilkins Model 375-OSY or equal.

The reduced pressure detector assembly shall be similar in all respects to the FEBCO Model 826YD (OS&Y), Watts Series 909-RPDA, Wilkins Model 375-RPDA or equal.

VALVE TAMPER SWITCH

Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

Valve Supervisory Switch shall be by McWane, Inc.; Kennedy Valve Division, Potter Electric Signal Company or System Sensor.

PART 3 - EXECUTION

GENERAL:

Install valves in the locations as shown on the drawings, plumb and centered and in absolutely true alignment. Support valves against settlement and misalignment with a suitable, lasting material as approved by the Engineer.

Clean valve interior of all foreign matter before installation. Tighten stuffing boxes and inspect valve in open and closed position to assure that all parts are working properly.

PAINTING:

Paint all exposed ferrous metal with two coats of asphalt varnish such as 667 Utility Black by Tnemec, unless otherwise directed by the Engineer.

BURIED SERVICE VALVES:

Install valve boxes for gate valves as indicated on the drawings. Adjust length of valve box to bring valve box cover to finished grade elevation. Center valve box over operating nut so that it fits around the stuffing box and rests on compacted ground. Align valve box so that it is plumb. Place and compact material in layers around valve box so as to prevent misalignment or shifting of the valve box or cover.

Where pavement is existing or proposed, the valve box shall be adjusted to finished street grade. When valve boxes are located in grassed or non-paved areas, install a pre-cast concrete collar (6" thick with 12" radius to the outer edge) to final grade.

Valve boxes shall be installed so that a minimum of four inches (4") of upward and four inches (4") of downward (total of eight inches (8")) vertical adjustment is possible without disturbing the base or removal of any box sections unless directed otherwise by Engineer. Valve boxes for 2" ball valves shall be supported by two (2) bricks.

The Contractor shall adjust valve boxes to final grade at the time designated by the Engineer. No additional compensation will be made for valve box adjustment.

Valve Tamper Switches shall be installed on all post-indicator valves and Reduced Pressure Detector Assemblies.

END OF SECTION 332120

SECTION 332130 – WATER PIPE ACCESSORIES

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of work covering pipe accessories includes furnishing, installing, and making operational all accessories as indicated on the drawings and specified herein.

Related Work Specified Elsewhere:

Common Work Results for Utilities: Section 330500

Water Pipe and Pipe Fittings: Section 332110

Water Valves: Section 332120

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards

Manufacturer's Capabilities: Supplier of accessory items shall be regularly engaged in the manufacture of products of types and sizes required, and which have been in satisfactory use for not less than one year in similar service.

SUBMITTALS:

Shop Drawings: Submit shop drawings or product data for all accessory items.

PART 2 - PRODUCTS

GENERAL:

Provide factory-fabricated piping accessories as hereinafter specified for use in the service indicated. Provide products of the type and pressure-rating indicated for each service or, if not indicated, provide proper selection as determined by the piping system installer to comply with installation requirements. Provide sizes and connections matching pipe, tube, valve and equipment connections.

Fire Hydrants: Fire hydrants shall be in accordance with AWWA Standard C502, latest revision thereof, suitable for an operating pressure of not less than 150 pounds per square inch and shall have a traffic breakable feature (safety flange and stem coupling), dry top, sealed lubrication reservoir and a main valve which is held closed with pressure. The hydrant body shall be of cast iron with "O" ring seals and bronze threads on the seat ring and drain ring, and shall have two (2) 2 1/2-inch nozzles and one (1) 4 1/2-inch nozzle with caps having National Standard threads. The hydrant main valve shall be a minimum of 5 1/4 inches in diameter. All continuously wetted hydrant parts and surfaces shall be of corrosion resistant materials or be epoxy coated with epoxy recognized by AWWA for potable water use. The epoxy coating shall be of a color other than black (unless the work "epoxy" is stenciled on the base) to permit distinction between standard and epoxy coatings to be made easily. Hydrants shall be American Flow Control B-84-B, Clow Medallion or Mueller A-423.

The inlet shoe for fire hydrant shall have a six inch (6") inside diameter and shall be cast or ductile iron with mechanical joint fittings in accordance with AWWA Standard C110.

Locked hydrant tees and fittings for fire hydrants shall meet the requirements of AWWA Standard C-111 (ANSI A21-11). Locked tees shall be as manufactured by American Cast Iron Pipe Company, Clow, U.S. Pipe, or approved equal.

Detectable Marking Tape (Tracing Tape): Tape shall be three (3) inches in width with a minimum thickness of 0.5 millimeters (minimum solid center foil thickness of 0.35 millimeters). Color of the tape shall be blue meeting the American Water Works Association color code. Tape shall read: "Caution- Buried Water Line Below". Tape shall be manufactured by Lineguard, Inc., Pro-Line Safety products Co., Empire Level Mfg. Corp., or approved equal.

Heated Insulated Enclosure: The enclosure manufacturer shall be a company specializing in the manufacture of such enclosures with at least five (5) years of successful field experience and being lab certified as meeting A.S.S.E 1060 requirements. The enclosure shall be manufactured of Mill finish aluminum, ASTM B209. Insulation shall be polyisocyanurate foam: spray applied, frothed in place or board stock laminated between two (2) layers of fiberglass mat.

The insulation shall have the following properties:

1. Dimensional stability - less than 2% linear change.
2. Comprehensive strength - 20 PSI.

3. Water absorption - less than 1% by volume.
4. Density - nominal 2.0 lbs. per cubic foot.
5. Flame spread -25.
6. Service temperature - 100 degrees F to
7. 250 degrees F.
8. Insulation thickness shall be 1" for enclosures up to 2" IPS and 1.5" for 2.5 " IPS and above.

The roof, walls and access panels shall be constructed of the specified materials in the specified thicknesses. Multi-sectional enclosures shall fit together with overlapping "tongue and groove" joints and be secured internally with mechanical fasteners. The enclosure shall be securely attached to a concrete base with anchor brackets installed on the interior of the enclosure, through the flange base of the enclosure itself or through a stainless steel anchor hinge. Access panels shall be provided to allow easy access for operation, maintenance and testing of backflow prevention assembly without removal of assembly. Access panels shall be secured with padlock hasps and staples. Drain openings shall be designed to remain closed except when device is discharging water. Openings shall be designed to accommodate the maximum discharge of the device, and, shall protect against intrusion of wind, debris and animals, through the use of separate aluminum screen and wind flaps.

Heating Equipment shall be furnished and designed by the manufacturer of the enclosure to maintain and interior temperature of +40 degrees F with an exterior outside temperature of -30 degrees F and a wind velocity of 15 MPH. The factory assembled heating equipment shall be UL, ETL, or CSA certified. Electric power source for heat and accessories shall be G.F.I. protected, with 18" clearance from receptacle base to grade.

Mounting Hardware shall be furnished and shall be stainless steel. All assembly fasteners shall be stainless steel or aluminum. Anchor hardware shall be adjustable up to 1.5" vertically to accommodate uneven concrete slabs.

PART 3 - EXECUTION

GENERAL:

Install all piping accessories as shown on the drawings complying with all applicable portions of Section 02511 - Pipe and Pipe Fittings, manufacturers' instructions and as directed. Provide accessories of the sufficient size and ratings if not shown to complete and make ready for service all piping systems.

Touch-up paint all surfaces where the primer paint has been damaged or scarred during installation.

All ferrous-metal surfaces for underground installation shall be coated with a bitumastic paint.

END OF SECTION 332130

SECTION 332140 - WATER SERVICES

PART 1 - GENERAL

RELATED DOCUMENTS

The general provisions of the Contract, including the General and Special Conditions and Division - 1 Specification sections apply to work of this section.

DESCRIPTION

The extent of work covering services includes furnishing, installing and making operational all water service items as indicated on the drawings and specified here.

Related Work Specified Elsewhere:

General Provisions: Section 330500
Pipe and Pipe Fittings: Section 332130

QUALITY ASSURANCE:

Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise shown or specified.

AWWA: All applicable standards
Greenville Utilities Commission Design Manual

Manufacturer's Capabilities: Supplier of water service items shall be regularly engaged in the manufacture of products of types and sizes required, and which have been in satisfactory use for not less than five years in similar service.

SUBMITTALS:

Shop Drawings: Submit shop drawings or product data for all water service items.

PART 2 - PRODUCTS

GENERAL:

Provide factory-fabricated water service materials as hereinafter specified for use in the manner indicated. Provide products of the type, size and pressure-rating indicated or required. The materials for ¾" and 1" services are identical except for the meter which is installed by the Commission. Also, materials for 1-1/2" and 2" services are identical except for the meter vault which is installed by the Commission.

Materials for ¾" and 1" Water Services

Service Saddles: Service saddles shall be made of materials conforming to AWWA copper alloy No. C83600 with 1" (AWWA) CC outlet thread and an O-ring cemented in a confined groove. Service saddles shall be only those listed below.

<u>Type Main</u>	<u>Main Size</u>	<u>Approved Saddle Mfg & Model #</u>
PVC (IPS)	2"	Ford S70-204, Mueller H-13420, Hayes 527 A.0400 Series, A Y McDonald Style 3801
ACP/DIP/CIP	4" - 12"	Ford Style 202B, Mueller BR 2 B Series, A Y McDonald Style 3825
PVC (C-900)	4" - 12"	Ford S90 Series, Mueller H-13440 thru 13444 Series, A Y McDonald Style 3805, Hayes 527 Series
PVC (Sch 40 IPS) Steel Pipe	4"- 12"	Ford S70 Series, Hayes 527 Series, Mueller H-13428 through H-13435 Series, A Y McDonald Style 3801

Corporation Stops: One-inch (1") corporation stops shall be bronze body with (AWWA) CC tapered threaded inlet and compression connection outlet. Stops shall be Hayes 4400 CJ, Mueller P-15008, or Ford F1000-4, A Y McDonald 4701-22, or approved equal.

Service Tubing: Service tubing shall be 1" diameter seamless copper type K suitable for underground water services. Materials shall be supplied in conformance with ASTM B88, type K.

Angle Ball Valve Meter Stop: One inch angle ball valve meter stops shall be bronze body with compression seal inlet connection and threaded outlet for meter connection. Stops shall be Ford BA43-444W, Hayes 2520CJ, A Y McDonald 4602B-22, Mueller P-24258, or approved equal.

Service Couplings: Service Couplings for 1” water services shall be bronze body with compression seal inlet connections with a stainless steel set screw. Couplings shall be Ford C44-44, Hayes 5615CJ, A Y McDonald 4758-22, Mueller p-15403, or approved equal.

Water Meter Boxes: Water meter boxes shall be manufactured of Class 30 cast iron in conformance with ASTM-A48 (latest revision thereof). The manufacturer’s name and part number shall be cast into each component and the words “water meter” shall be cast into the cover. Boxes shall be Vulcan Foundry G8404-1 Frame with G8404 lid or a Sigma MB382 Capitol Foundry MBX1

Materials for 1-1/2” and 2” Water Services

Service Saddles: Service saddles shall be made of materials conforming to AWWA copper alloy No. C83600 with 2” (NPT) FIP outlet thread and an O-ring cemented in a confined groove. Service saddles shall be only those listed below.

<u>Type Main</u>	<u>Main Size</u>	<u>Approved Saddle Mfg & Model #</u>
PVC (IPS & Sch. 40)	4" – 12"	Ford S71 Series, Hayes 527P Series, A Y McDonald Style 3802
ACP/DIP/CIP	4" - 12"	Ford Style 202B, Mueller BR 2 B Series, A Y McDonald Style 3826
PVC (C-900)	4" - 12"	Ford S91 Series, Mueller H-13490 thru 13494 Series, A Y McDonald Style 3806, Hayes 529P Series

Ball Valve: Ball Valves shall be bronze body with tee head. The turn required to travel from fully closed to fully open position shall be 90 degrees. Ball valves shall incorporate a check allowing a maximum turn of 90 degrees. Ball valves shall be Hayes 4300, Ford B11-777, A Y McDonald 6101, Mueller B-20283, or approved equal.

Service Piping: Service pipe shall be PVC Class 200 (IPS) and conforming to the latest revisions of ASTM D1784 and ASTM D2241. The pipe joints shall be of the integral bell type with rubber gaskets conforming to ASTM D31139 and F477. The pipe shall be SDR 21 and shall bear the National Sanitation Foundation seal for potable water. Fittings shall be schedule 80 PVC with solvent weld joints.

PART 3 - EXECUTION

GENERAL:

Install all water service items as shown on the drawings complying with manufacturer instructions and as directed. Provide water service materials of required size to complete and make ready for service to customer.

Services shall be provided to each lot or individual building unit as required by Section 3.2.9 of the GUC Design Manual and as shown in the Standard Details. Meter boxes and brick for one-inch (1") services shall be provided by the Contractor as shown on the Standard Details. Meter boxes installed for multi-family developments and ganged together shall be marked with the unit number being served. Markings shall be permanently painted on the inside of the frame section and highly visible.

Standard services are available utilizing 3/4", 1", 1 1/2", and 2" meters. Service tubing for 3/4", and 1" services shall be 1" diameter. Service pipe for 1-1/2" and 2" services shall be 2" diameter. For additional information, refer to the Standard Details. Larger services such as four-inch (4"), six-inch (6"), eight-inch (8"), etc., may be specified. Services larger than two-inch (2"), if used, shall be designed as a dead-end water main except that a permanent blow-off rather than a hydrant may be provided for flushing purposes.

Service connections for one-inch (1") services shall be installed by one of two (2) methods. These are as follows:

Service connections to PVC (C900) and ductile iron mains six inches (6") in diameter or larger may be accomplished by direct tapping of the main. Teflon tape or other approved pipe compound shall be applied to the corporation stop threads prior to installation.

Service connections for mains smaller than six-inches (6") and all sizes of pressure rated PVC require the use of a service clamp. A service clamp shall also be used as an alternative to tapping wherever required by the Commission.

One-inch (1") service tubing shall be installed with sufficient slack to prevent tension on the line. A maximum of three splices (couplings) per service shall be allowed. Tubing shall have a minimum cover of twenty-four inches (24"). See the Standard Details.

Service tubing shall be installed with a minimum of six inches (6") of vertical separation from an existing or proposed storm drain.

If the service tubing is damaged during construction such that its flow capacity or its life expectancy is adversely affected, the damaged portion shall be replaced.

One and one-half inch (1-1/2") and two-inch (2") diameter services shall be installed in accordance with the Standard Details. The installation of the Class 200 PVC service pipe shall

be in strict conformance with the requirements for mains, except that the service pipe shall have a minimum cover of twenty-four inches (24").

END OF SECTION 332140

SECTION 333100 - GRAVITY SANITARY SEWER SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including the General and Special Conditions and Division-1 Specification sections apply to work of this section.

DESCRIPTION OF WORK:

The extent of sanitary sewer system work is shown on the drawings.

Types of sanitary sewer facilities include the following:

Service Laterals

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200

Concrete Paving: Section 321313

QUALITY ASSURANCE:

Codes and Standards: Comply with applicable standards contained herein and with the requirements of NCDENR.

Testing and Inspection: Contractor shall provide all necessary equipment and materials and shall perform the visual inspections, air testing and infiltration testing of the system in conformance with the requirements of this section.

SUBMITTALS:

Material Certificates:

Provide materials' certificates for pipe and manholes.

Shop Drawings: Submit shop drawings and/or product data for all pipe and fittings, pipe gaskets, transitions, precast manholes, sewer brick, manhole covers and frames, and manhole steps.

PART 2 - PRODUCTS

SERVICES:

Sewer Service Pipe: Sewer service pipe shall be Schedule 40 PVC- Drain, Waste and Vent (DWV) pipe in accordance with ASTM D2665 and ASTM D1785. Cleanouts shall be constructed of pipe and fittings which also meet the ASTM requirements for Schedule 40 PVC-DWV pipe. Cleanout caps shall be Charlotte 110 or Jones BP134CSK flush cap. Cleanouts in traffic or paved areas shall be installed with a sewer cleanout box set to finished grade as shown in the standard details.

Service Fittings: Service saddles for use with ABS composite sewers shall be ABS saddle wyes as manufactured by Contech Construction Products, Inc. or approved equal. Wyes shall be chemically welded using the manufacturer's recommended primer, cement, and stainless steel bands.

Service fittings for use on PVC Composite Pipe shall be PVC standard gasketed wyes manufactured or approved by the pipe manufacturer and shall conform to the requirements of ASTM D2680.

Service fittings for use on PVC (SDR 35) pipe shall be standard gasketed wyes manufactured or approved by the pipe manufacturer and shall conform to the requirements of ASTM D3034.

Transition Coupling: Pipe material changes between manholes may be permitted provided there is not a substantial difference in inside diameters, a smooth uniform flow line is maintained, and a watertight rubber sleeve or mechanical coupler conforming to ASTM C-425 is used to make the transition. All metal hardware shall be stainless steel. Transition sleeves shall be manufactured by Fernco or Indiana Seal.

PART 3 - EXECUTION

GENERAL:

Adherence to Standards and Instructions: All pipe shall be transported, handled, stored, and installed in keeping with applicable AWWA/ASTM standards and manufacturer's instructions for the particular pipe material involved.

Responsibility for Materials: During loading, transportation, unloading and storage, every precaution shall be taken to prevent damage to pipe, fittings, and accessories and to keep them free from dirt and foreign matter at all times. Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks or free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate specifications. ABS or PVC pipe shall be protected from ultra-violet rays and from warping in accordance with manufacturer's recommendations.

INSTALLATION:

Pipe Laying: Each joint of pipe shall be carefully examined before being laid. Defective pipe shall be clearly marked and placed aside. Defective pipe shall not be installed.

Provide proper facilities for lowering pipe into trenches.

Ensure that the pipe bedding is set at true line and grade and is in conformance with the specifications.

Pipe shall be laid true to line and grade as designated on the plans with ends abutting. Each joint shall be tested for exact position by use of grade rod and plummet or laser. Carefully center the pipe so that when laid, they will form a sewer with a uniform invert. Ensure that when joining pipes of different wall thickness the inverts of the pipe joints form a smooth line.

Pipe having its grade or joint disturbed after laying shall be taken up, cleaned and relaid.

Pipe installed by use of laser shall be checked for proper grade with engineering level and grade rod at each manhole prior to continuing pipelaying operations. Additional checks every 50 feet may be required by the Engineer.

The Contractor shall not be allowed to skip any section of the pipe line and move further upgrade, except as special permission is granted by the Engineer, or when the Contractor has more than one complete pipe laying crew working on the project.

Stone embedment shall be as indicated in Trenching, Backfilling, and Compaction Section 02220.

All pipe shall be laid so that markings are on top. All pipe in place shall be inspected before being covered or concealed.

Keep trenches water-free and as dry as practicable during bedding, laying and jointing. Place sufficient backfill along each side of pipe as soon as practicable to brace pipe on line and grade.

Place a plastic stopper or other suitable device in the end of the last joint of pipe at the conclusion of each day's work or at other times when pipe laying is not in progress.

Prevent the entry of water, dirt, tools or other foreign matter into the pipe line.

Ensure that bedding and backfill is installed in conformance with requirements of Trenching, Backfilling and Compaction Section 02220.

All joints shall be made in accordance with manufacturer recommendations. Ensure that the pipe is installed with at least a 1/8 inch per foot slope. Plug each service securely with a watertight plug.

TESTING AND INSPECTION OF SYSTEM:

Testing and inspection shall promptly follow installation of wastewater pipe including services. Testing shall not be more than 1,000 feet behind wastewater pipe laying operation.

Furnish all pumps, gauges, instruments, test equipment and personnel required for inspection and testing operations.

All final testing and inspections shall be performed in the presence of the Resident Project Representative.

Inspect the system for conformance with line and grade shown on the plans and provide record drawing measurements per Section 01300 - Submittals. The maximum allowable drift between structures from proposed alignment is:

Horizontal alignment:	0.20 foot
Vertical Grade:	0.05 foot

Inspect the system for visible leaks (air or water). Repair all visible leaks. Correct all deviations from line and grade.

Materials removed to correct deficiencies revealed by tests and inspections shall not be reused. Pipe removed due to faulty grade shall be replaced with new pipe.

The following test sequence shall be included in the Contract Documents for all wastewater system extension unless otherwise permitted by the Engineer.

1. Perform a visual inspection.
2. Correct defects revealed by visual inspection.
3. Perform leakage testing.
4. Make any necessary repairs.
5. Make the necessary retests.

Leakage Testing For Gravity Sewers:

Unless otherwise permitted or required by the Engineer, leakage testing for gravity sewers shall be by low-pressure air test. Infiltration or exfiltration testing of the lines in lieu of air testing shall not be accepted without prior written approval of the Engineer. All visible leaks shall be corrected regardless of the results of testing. All services, including those which discharge directly into manholes, shall be leakage tested.

END OF SECTION 333100

SECTION 334100 - STORM SEWER SYSTEM

PART 1 - GENERAL

RELATED DOCUMENTS:

The general provisions of the Contract, including General Supplemental General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Related Work Specified Elsewhere:

Trenching, Backfilling and Compaction: Section 312200

Concrete Paving: Section 321313

DESCRIPTION OF WORK:

The extent of storm sewer system work is shown on the drawings.

Storm sewer system work includes, but is not limited to, all of the following.

Storm sewer pipe.

Drop inlets, frames and gratings.

Curb inlets, frames and gratings.

Reinforced concrete and brick junction box.

QUALITY ASSURANCE:

Code and Standards: Comply with requirements of applicable Division - 2 sections for excavation and backfilling required in connection with storm sewer system work.

SUBMITTALS:

Shop Drawings, Storm Sewer and Sanitary Sewer System: Submit shop drawings for the system, including details of underground structures, metal accessories, fittings, and connections, and any variations from those details shown on the drawings.

PART 2 - PRODUCTS

CONDUIT MATERIALS:

Reinforced Concrete Pipe (RCP): Concrete Pipe shall be in accordance with ASTM C-76, Class III. All pipe shall have tongue-and groove type joint. All pipe shall be stamped by supplier - "R.C.". Joint material shall be RAM-NEK Performed Plastic Gasket, Type I rope form sealing compound conforming to Federal Specifications SS-S-210A.

Polyvinyl Chloride (PVC): PVC storm sewer pipe and fittings shall be manufactured and tested in accordance with ASTM F949. PVC pipe shall be manufactured from 12454 cell class material per ASTM D1784. Pipe and fittings shall have a minimum pipe stiffness of 46 lbs/in/in when tested in accordance with ASTM D2412. Joints shall be integral bell-gasketed joint.

MASONRY MATERIALS:

Concrete Masonry Units (Manhole Block): ASTM C 139.

Manhole Drop Inlet and Catch Basin Brick: ASTM C 32, Grade MS.

Concrete Brick: ASTM C 55, Grade N1.

Masonry Mortar: ASTM C 270, Type M, approximately 1:1/4:2 Portland cement, lime, sand.

Concrete Block: ASTM C-90, Grade N 1.

For minor amounts of mortar, packaged materials complying with ASTM C 387, Type M, will be acceptable.

Plasticizing Agent - Omicron or equal. Use in accordance with manufacturer's instructions.

METAL ACCESSORIES:

General: All metal accessories for manholes, catch basins and drop inlets shall be gray cast iron, ASTM A 48, Class 30B. Frames, grates and covers shall be factory coated with an asphalt base paint. Install metal accessories as shown on the drawings and as follows:

Manhole frames and covers shall be NCDOT Roadway Design Std. No. 840.54. Furnish covers with cast-in legend "Storm" on roadway face.

Catch basin frames and grates shall be NCDOT Roadway Design Std. No. 840.03 Type "E."

Drop inlet frames and grates shall be NCDOT Roadway Design Std. No. 840.16.

Manhole steps shall be plastic coated steel bar or cast iron as shown in NCDOT Roadway Design Std. No. 840.66.

Temporary Silt Fence: Temporary silt fence shall be accomplished in accordance with Section 1605 of the N.C. Department of Transportation Standard Specifications for Roads and structures dated January 2002 and as shown on the plans.

PART 3 - EXECUTION

INSPECTION:

Contractor must examine the areas and conditions under which storm sewer system work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

INSTALLATION OF CONDUIT (PIPE):

General:

Perform excavation, trenching and backfilling as specified in appropriate Division-2 Sections. Conduct backfill operations of open-cut trenches closely following laying, jointing and bedding of pipe, and after initial inspection and testing are completed.

Inspect conduit before installation to detect any apparent defects. Mark defective materials with white paint and promptly remove from the site.

Particular care shall be taken to prevent damage to pipe and fitting linings and coatings. Pipe shall be protected during handling against impact shocks and free fall.

Lay conduit beginning at the low point of a system, true to the grades and alignment indicated with unbroken continuity of invert. The line and invert grade of each pipe shall be checked from top line carried on batter boards not over 24' apart or by a laser and target.

Cross above or below other pipe a minimum of 6" unless otherwise directed by the Engineer.

Place bell ends of conduit or the groove end of concrete facing upstream.

Bell holes shall be excavated for each joint to assure bedding supports the barrel of the pipe and to facilitate making a perfect joint. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed or of the factory-made jointing materials shall be clean and dry.

Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

Cleaning Conduit: Clear the interior of conduit of dirt and other superfluous material as the work progresses.

Place plugs in the ends of uncompleted conduit at the end of the day or whenever work stops.

Flush lines between manholes if required to remove collected debris.

Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.

A light held in a manhole shall show a full circle of light when viewed from the adjoining end of the line.

Make inspections after lines between manholes, or manhole locations, have been installed and approximately two feet of backfill is in place and at completion of the project.

If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects to the satisfaction of the Engineer.

Connection to Existing Structures: Pipe connections to existing structures shall be made in such manner that the finished work will conform as nearly as practicable to the essential applicable requirements specified for new structures, including all necessary concrete work, cutting, and shaping.

UNDERGROUND STRUCTURES:

General: Drainage structures may be precast sections or constructed with concrete masonry units (manhole block) or concrete brick masonry as specified under Part 2 - Products unless otherwise noted. Construct all drainage structures with a grouted invert to channel flow through structure from inlet pipes to outlet pipe. Where pipes are skewed, the grouted channel shall form a smooth radius. Structures shall not be backfilled until inspected by the Engineer or his representative unless otherwise directed.

Construct all structures in accordance with all authorities having jurisdiction and as hereinafter specified.

Masonry Construction: At Contractor's option, use either concrete brick or concrete masonry (manhole block) units.

Mix mortar with only enough water for workability. Re-tempering of mortar will not be permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with, the ground.

Lay masonry in mortar so as to form full bed with ends and side joints in one operation, and with full bed and vertical joints, not more than 3/8" wide on the inside. Protect fresh masonry from freezing and from too rapid drying.

Catch basins and Junction boxes: Construct to the sizes and shapes as shown on the drawings and as specified.

Use concrete that will attain a 28-day compressive strength of not less than 3,000 psi.

Set cast iron frames and gratings to the elevations indicated.

END OF SECTION 334100

FORM OF PROPOSAL

PiTT COMMUNITY COLLEGE
NEW WELDING BUILDING
Winterville, NC

Contract:
Bidder:

SCO ID #22-25191-01A

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 Pitt Community College Board of Trustees in the form of contract specified, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of The Pitt Community College New Welding Building in full in complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, Pitt Community College Board of Trustees and JKF ARCHITECTURE PC 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:

GENERAL CONSTRUCTION CONTRACT(Single-Prime):

Base Bid:

Dollars (\$)

List Subcontractors:

- Sitework Subcontractor: License No.
Certified Mason: License No.
Metal Roofing Subcontractor: License No.
Fire Protection Subcontractor: License No.
Plumbing Subcontractor: License No.
Mechanical Subcontractor: License No.
Electrical Subcontractor: License No.

General Contractor shall complete all sections for Allowances, Alternates and Unit Prices for Single-Prime Proposal.

The General contractor shall act as project expeditor for all prime contracts. See Supplementary General Conditions.

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions. Applicable liquidated damages shall be stated in the Supplementary General Conditions Article 23.

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.

ALTERNATE BIDS (See Specification Section 012300 for complete description and time requirements)

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).

Alternate Bid No. 1 – Add Two Additional Classrooms.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 2– Add Exterior Canopies.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 3– Preferred Alternate; Fire Alarm- JCI/Simplex.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 4– Preferred Alternate; Building Controls- Schneider Electric.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 5– Preferred Alternate; Boilers- Lochinvar.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 6– Preferred Alternate; Chillers- Trane.

Total Add/Deduct: _____ Dollars (\$ _____)

Alternate Bid No. 7– Preferred Alternate; Corbin-Russwin Door Hardware.

Total Add/Deduct: _____ Dollars (\$ _____)

UNIT PRICES (See Specification Section 012200 for complete description and time requirements)

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents

Unit Price No. 1– Remove and replace unsuitable soils in building pad or parking areas.

Total: _____ Dollars (\$ _____ per CY).

Unit Price No. 2– Remove and replacement unsuitable soils in footings, foundations, and utility trenches.

Total: _____ Dollars (\$ _____ per CY).

Unit Price No. 3 – Provide geotechnical fabric, geogrid, or other suitable stabilization material.

Total: _____ Dollars (\$ _____ per SY)

ALLOWANCES (See Specification Section 012100 for complete description and time requirements)

Allowance quoted are included in the Base Bid amount and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

Allowance No. 1: Remove unsuitable soils.

Total: _____ Dollars (\$ _____).

Allowance No. 2: Remove unsuitable soils (#57 Stone)..

Total: _____ Dollars (\$ _____).

MINORITY BUSINESS PARTICIPATION REQUIREMENTS:

Provide with the bid - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

NOTE: A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

After the bid opening - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

*** OR ***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Note: Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit **A** **or** Affidavit **B**, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

PROPOSAL SIGNATURE PAGE

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bond within ten (10) consecutive calendar days after written notice being given 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.

Attach certified check, cash or bid bond to this proposal.

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. _____

E-mail Address: _____

(CORPORATE SEAL)

Addendum received and used in computing bid:

- Addendum No. 1 _____
- Addendum No. 2 _____
- Addendum No. 3 _____
- Addendum No. 4 _____
- Addendum No. 5 _____
- Addendum No. 6 _____
- Addendum No. 7 _____
- 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.

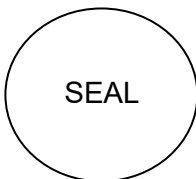
The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure 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

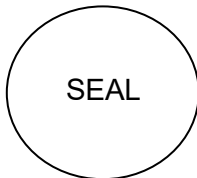
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

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.**

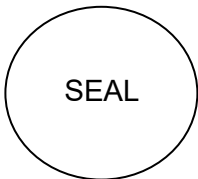
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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 ID# _____ (Project Name) Amount of Bid \$ _____

I will expend a minimum of _____% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

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

**** HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Examples of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- 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.

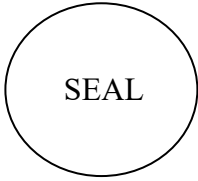
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

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 _____

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 Trustees of Pitt Community College as
obligee, in the penal sum of _____ DOLLARS, lawful money
of the United States of America, for the payment of which, well and truly to be made, we bind
ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly
by these presents.

Signed, sealed and dated this ____ day of ____ 20__

WHEREAS, the said principal is herewith submitting proposal for
and the principal desires to file this bid bond in lieu of making
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if
the principal shall be awarded the contract for which the bid is submitted and shall execute the
contract and give bond for the faithful performance thereof within ten days after the award of same
to the principal, then this obligation shall be null and void; but if the principal fails to so execute
such contract and give performance bond as required by G.S. 143-129, the surety shall, upon
demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided
further, that the bid may be withdrawn as provided by G.S. 143-129.1

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

_____(SEAL)

FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the _____ day of _____ in the year of 2024 by and between

_____ hereinafter called the Party of the First Part and The Trustees of Pitt Community College; 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:

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:

**PITT COMMUNITY COLLEGE
NEW WELDING BUILDING
SCO ID #22-25191-01A**

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 425 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 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:

- X
- X
- x
-

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in _____ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

Contractor:(Trade or Corporate Name)

(Proprietorship or Partnership)

By: _____

Attest: (Corporation)

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec. only)

(CORPORATE SEAL)

The Trustees of Pitt Community College

By: _____

Title: _____

Witness:

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)

By: _____

Attest: (Corporation)

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

By: _____

Title: _____
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

(Surety Company)

Witness:

By: _____

Title: _____
(Attorney in Fact)

Countersigned:

(Surety Corporate Seal)

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

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)

Contractor: (Trade or Corporate Name)

By: _____

Title: _____
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

(Surety Company)

By: _____

Title: _____
(Attorney in Fact)

Witness:

Countersigned:

(N.C. Licensed Resident Agent)

Name and Address-Surety Agency

Surety Company Name and N.C.
Regional or Branch Office Address

(Surety Corporate Seal)

Sheet for Attaching Power of Attorney

Sheet for Attaching Insurance Certificates

APPROVAL OF THE ATTORNEY GENERAL

**CERTIFICATION BY THE OFFICE OF STATE
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the _____

_____ under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This _____ day of _____ 20__.

Signed _____
Budget Officer

STATE OF NORTH CAROLINA
 COUNTY SALES AND USE TAX REPORT
 SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: _____

Page _____ of _____

PROJECT: _____

FOR PERIOD: _____

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

* Attach subcontractor(s) report(s)
 ** Must balance with Detail Sheet(s)

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

Sworn to and subscribed before me,

This the _____ day of _____, 20____

 Signed

 Notary Public

My Commission Expires: _____

 Print or Type Name of Above

Seal

NOTE:
 This certified statement may be subject to audit

STATE OF NORTH CAROLINA
 SALES AND USE TAX REPORT DETAIL

CONTRACTOR: _____

Page _____ of _____

SUBCONTRACTOR _____

FOR PERIOD: _____

PROJECT: _____

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				\$	\$	
TOTAL:					\$	

* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.

